From learning objectives to student's competence

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From learning objectives to student's competence

Transformation into a pharmacotherapy context-learning programme

Joke A Vollebregt

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Transformation into a pharmacotherapy context-learning programme

The studies presented in this thesis were performed at the VU University Medical Center Amsterdam, the Netherlands.

Three studies, presented in chapter 2-4, were financially supported by grants from the Dutch Ministry of Public Health, Welfare, and Sports (VWS), the Dutch College of Insurance Companies (CVZ) and the Dutch Association of the Research-based Pharmaceutical Industry (Nefarma).

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From learning objectives to student's competence

Transformation into a pharmacotherapy context-learning programme

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor aan
de Vrije Universiteit Amsterdam,
op gezag van de rector magnificus
prof.dr. T. Sminia,
in het openbaar te verdedigen
ten overstaan van de promotiecommissie
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door

Johanna Adriana Vollebregt

geboren te Wieringermeer

promotoren:	prof.dr. Th.P.G.M. de Vries
	prof.dr. J.C.M. Metz
	prof.dr. M. de Haan
copromotor:	dr. J.G. Hugtenburg

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Preparations for 3rd year CLP

2000 Starting 3rd year CLP
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2001 Starting 4th year CLP and OSCE

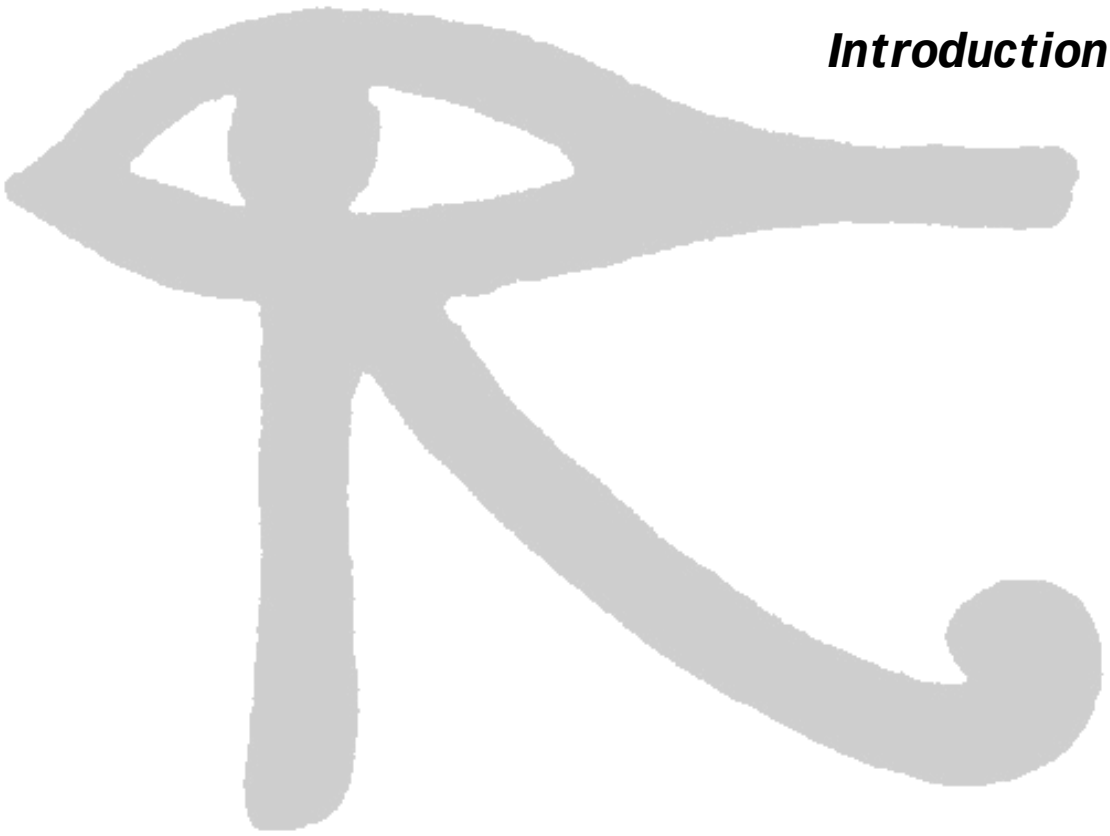
2002 Study 4: Pharmacotherapy context-learning programme

2004 Thesis

(* chapters 2-4 are based on the reports written for the organisations who financially supported the studies 1-3 (see page 12)

Chapter 1

Introduction



In recent decades many new potential and effective drugs have been developed and, as a result, more and more diseases can now be adequately treated with drugs. However, the occurrence of adverse reactions may limit the effectiveness of drugs, and may even lead to significant morbidity and mortality rates and increased financial costs. Several studies have shown that adverse reactions can also result in hospital admission.[1-3]

A number of adverse drug reactions that can be prevented are the cause of medication errors. Both in general practice and in hospitals, these preventable errors in the prescription of drugs have been shown to include errors in the choice of drugs, the dosage, the form of dosage or the dosage schedule.[4-8]

Studies on preventable medication errors

A recent literature review on the incidence of adverse drug reactions and outcomes related to preventable adverse drug reactions in hospitalised patients, showed that the median frequency of adverse drug reactions was 1.8%, with a range from 1.3% to 7.8%. The median preventability rate was 35.2%, with a range from 18.7% to 73.2%. Most of these adverse drug reactions occurred in the stage of drug prescription, and were dose-related. Inappropriate drug-prescribing and insufficient patient-monitoring were the most frequently identified causes of preventable adverse drug reactions.[9]

In a prospective study performed at a teaching hospital in the UK the causes of prescribing errors were examined, and prescribers who made potentially serious errors were interviewed. The results of this study showed that most of the errors were made because of a lapse of attention or because prescribers did not apply the relevant rules. The doctors themselves also identified many risk factors, such as work environment, work-load, communication within their teams, physical and mental well-being and lack of knowledge. Other factors included inadequate training, low perceived importance of drug-prescribing, a hierarchical medical team and the absence of personal awareness of the errors. It was remarkable that senior house officers and junior house officers made the most errors. All major medical and surgical specialists were represented in this study.[8]

Irrational drug prescribing

In addition to the occurrence of serious medication errors, resulting in severe side-effects or hospitalisation, there are also indications that irrational drug prescribing is a general problem in medical practice. Examples of this phenomenon include the prescription of drugs not related to the diagnosis, the prescription of relatively expensive drugs, irrational prescription of antibiotics and unnecessary continuation of drug treatment in the elderly, leading to polypharmacy.[10]

Attempts to improve the quality of drug-prescription are partly successful

In order to address the problem of irrational drug-prescribing and the occurrence of prescribing errors, several measures have been taken by medical organisations and governments. On the one hand, standards and guidelines for drug treatment have been developed and implemented in the continuing postgraduate medical education with the aim to improve drug-prescription. On the other hand, cost-saving measures have been implemented, for example through the reimbursement system. These measures have contributed to the improvement of the drug-prescription. However, despite these measures medical doctors do not easily change their practice routines including their drug-prescribing behaviour. Examples of reasons are lack of time in a busy practice, patient demands, and the subjective influence of the pharmaceutical industry.[11;12]

Medical doctors may not be adequately trained in pharmacotherapy

Another plausible explanation for the afore-mentioned phenomenon is that medical doctors have not been adequately trained in rational drug prescribing.[8;13] Education in clinical pharmacology and therapeutics is still not a core element in most medical curricula, and the drug prescribing competence of medical students has rarely been explicitly assessed.[14-16] In the Netherlands, this problem has been the subject of debates since the early nineties. In 1992 the first external review of the entire undergraduate medical training programme was initiated by the Association of Universities in the Netherlands (VSNU). It was concluded that the pharmacotherapy education was satisfactory in only two of the eight medical faculties.[17] In 1993, a committee consisting of pharmacology and pharmacotherapy teachers analysed the pharmacology and pharmacotherapy

training programmes of the medical faculties. The committee reached the conclusion that clinical pharmacology and pharmacotherapy education and assessment should be improved, although some positive developments had taken place.[18] After the second external programme review, in 1997, it was advised that the students should be involved in the prescription of drugs for patients during their clinical clerkships, and that their level of competence in choosing and prescribing drugs should be explicitly assessed.[19] It can be concluded that in medical doctors at the time of graduation, there were strong indications that the rationality of choosing and prescribing drugs was insufficient. This might well be an important cause for irrational prescription in daily practice.

Overview of the medical curricula in the Netherlands in the early nineties

The undergraduate medical curricula in all medical faculties in the Netherlands consisted in general of a pre-clinical phase of 4 years, followed by clinical clerkships for a period of 2 years. In the pre-clinical phase, students were taught the theory of anatomy, physiology, pathophysiology and clinical features, including pharmacology and the drugs used to treat the diseases of the organ systems. In most curricula the students, divided into small groups, learned to apply the previously gained knowledge to solve a patient's medical problems. One can say that gaining knowledge, followed by learning to apply this knowledge is a form of sequential learning. After the pre-clinical phase, in almost all of the medical faculties, 5th year students began their clinical clerkships, starting with clinical skills training for a period of six weeks, which included training in pharmacotherapy skills. The training was followed by clinical clerkships of two to twelve weeks in all major clinical departments and in general practice so that the students learned to apply their knowledge in clinical practice. During the final clerkship, the students were gradually given more responsibility. One can say that both the pre-clinical phase and the clinical clerkships of the medical curricula were mainly based on sequential learning.

Developments in medical education

Since then, various changes have been made in the curricula in favour of confronting students with patient problems at an earlier stage in their study. All these changes are mainly based on the growing evidence that gaining knowledge

combined with applying knowledge, is more effective than sequential learning.[20] This is explained by theories originating from cognitive psychology and their application in medical problem-solving. The way in which knowledge is stored in the memory determines to a great extend the availability of the knowledge when it has to be recalled or applied. If the knowledge is gained simultaneously with solving patient problems, it will be stored in combination with the problems to which it has to be applied. When the student has to solve such patient problems, for example during a clinical examination or in clinical practice, the knowledge is recalled much more accurately and rapidly.[21;22] These theories are mainly based on studies of diagnostic problem-solving and form the basis of innovations in medical education. Compared to the traditional (sequential) method of education, students are confronted with patient problems in an earlier phase of their study. However, little is known about the effect of learning to solve pharmacotherapeutic patient problems simultaneously with gaining knowledge of pharmacology.

Research project for the development of a pharmacotherapy curriculum

Between 1995 and 2002, an educational research project was conducted at the VU Medical Centre Amsterdam in the Netherlands. The general aim was to evaluate the level of competence in pharmacotherapy of medical students nearing graduation, and to seek ways to improve it, if necessary. Competence is defined as what a person is capable of doing in an observed/examination setting.[23] With regard to pharmacotherapy, competence mainly consists of skills and attitudes. Four studies were conducted, and within the framework of this overall aim, the following research questions were formulated:

1. What are the pharmacotherapy learning objectives of the undergraduate medical curriculum in the Netherlands?
2. Do medical students nearing graduation meet the requirements defined in the learning objectives with regard to pharmacotherapy skills?
3. Are pre-clinical students able to learn the cognitive pharmacotherapy skills simultaneously with gaining the necessary knowledge of pharmacology and pharmacotherapy?
4. What is the effect of a longitudinal context-learning programme for pharmacotherapy skills on the level of competence of pre-clinical 2nd–4th

year medical students as well as on their level of therapeutic knowledge, the study-load and their appreciation of the programme?

The first three studies were financial supported by grants from the Dutch Ministry of Public Health, Welfare, and Sports (VWS), the Dutch College of Insurance Companies (CVZ) and the Dutch Association of the Research-based Pharmaceutical Industry (Nefarma). The results of these studies have been reported to the financiers, but have not yet been published. Forming a part of this thesis, the reports have been rewritten in a scientific format (papers).

Outline of this thesis

Chapter 2 describes the findings of a national survey. In a literature survey the pharmacotherapy learning objectives of the undergraduate medical curriculum were identified. Subsequently, by applying a Delphi procedure, pharmacotherapy teachers reached maximum consensus on the required level of competence. Chapter 3 describes the results of a national survey, which was held to evaluate whether medical students nearing graduation met the requirements defined in the learning objectives for pharmacotherapy skills and the treatment of core diseases. Cognitive, communication and motor skills were distinguished. Chapter 4 reports the results of a controlled intervention study. The study focused on 3rd year pre-clinical students in two medical faculties. Based on theories regarding (medical) education, these students received a short training in cognitive pharmacotherapy skills. Chapter 5 presents the results of the implementation of a context-learning programme for pharmacotherapy skills. The development of this programme was based on the results of the previous studies and modern insights into medical education. Between 1998 and 2001 the programme was gradually implemented in the curriculum of the VUmc for all pre-clinical 2nd-4th year medical students. In chapter 6 the General Discussion, the results are discussed more generally within the context of clinical competence/performance and the conceptual model of clinical context-learning. The implications of the findings for the development of educational programmes in pharmacotherapy are discussed, and recommendations are made for future education programmes and future research in this field. The thesis concludes with a summary in both English and Dutch.

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Chapter 2

Learning objectives for undergraduate pharmacotherapy knowledge, skills and attitudes in the Netherlands; a national survey

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Abstract

Aim: To determine the pharmacotherapy learning objectives of the undergraduate medical curriculum in the Netherlands.

Methods: A survey among all eight medical faculties in the Netherlands. By means of a literature survey all published pharmacotherapy learning objectives were identified. These objectives were combined and ordered into 135 specific and 27 general objectives. The specific learning objectives describe the diseases and symptoms that final year students should be able to treat, and the general learning objectives describe in general the knowledge, skills and attitudes which are relevant for treating these diseases and symptoms. The two lists of learning objectives were sent to the heads of the departments of relevant disciplines, who were responsible for the pharmacotherapy training, in all eight medical faculties. They individually indicated the level of competence students nearing graduation need to achieve to master the treatment of each disease mentioned in the specific learning objectives. They also indicated the relevance of the general learning objectives, i.e. the knowledge, skills and attitudes. Subsequently, a Delphi procedure was applied to reach maximum consensus between the respondents.

Results: The required level of competence for 68 diseases and symptoms is the highest level: ability to choose and perform the drug treatment for any patient independently and according to the professional standard. For 37 diseases the required level is: 'ability to choose the treatment', and for 9 diseases 'knowledge of the drugs which are relevant for the treatment'. For the ability to treat patients with these diseases medical students should, in particular, have sufficient knowledge of the basic principles of pharmacology and clinical pharmacology, master all relevant cognitive, communication and motor skills, and should also have a critical attitude towards disturbing influences which might cause irrational drug-prescribing.

Conclusions: The core of the learning objectives consists of 68 core diseases. To be able to treat any patient with a core disease, medical students should master all relevant pharmacotherapy skills at the highest possible level: have sufficient knowledge of pharmacology, and a critical attitude towards irrational drug-prescribing.

Vollebregt JA, Metz JCM, Haan de M, Hugtenburg JG, Vries de TPGM. Learning objectives for undergraduate pharmacotherapy knowledge, skills and attitudes; a national survey. Submitted.

Introduction

Irrational drug prescribing seems to be a general problem in medical practice. Examples of this problem are the prescription of drugs that are not related to the diagnosis, the prescription of relatively expensive drugs, irrational prescription of antibiotics and unnecessary continuation of drug treatment in the elderly leading to polypharmacy. [1;2] In addition, it has been shown that both in general practice and in hospitals preventable errors are made in the prescription of drugs, such as errors in the choice of the drug, the dosage, the form of the dosage form or the dosage schedule. [3-6]

Irrational and expensive drug prescribing still occurs, despite the development of standards and guidelines for drug treatment, continuing medical education for doctors and cost-saving measures taken by governments. [1] This indicates that medical doctors do not easily change their drug-prescribing behaviour, due to various factors such as lack of time in a busy practice, patient demands and the subjective influence of the pharmaceutical industry. [7]

Another possible explanation is that these doctors have not, or have been inadequately taught how to prescribe drugs rationally. For example, there are indications that there is insufficient undergraduate training in clinical pharmacology and therapeutics. Unlike diagnostics, education in clinical pharmacology and therapeutics is still not a core element in most curricula, and the drug-prescribing competence of medical students has rarely been explicitly assessed. [8-11] Therefore, the level of competence with regard to the choice and prescription of drugs of medical doctors at the time of graduation was unknown, and it was also unknown whether medical doctors have been adequately trained to deal with the factors that cause irrational drug-prescribing in daily practice.

The aim of this study was to determine the pharmacotherapy learning objectives that medical students have to achieve at the time of graduation in the Netherlands. These learning objectives serve as a standard for the measurements described in the following three chapters of this thesis (chapter 3-5).

Method

Outline

By means of a literature survey, all published pharmacotherapy learning objectives were identified. Subsequently, two questionnaires containing a

selection of these objectives were sent to the heads of the departments of relevant disciplines, who were responsible for the pharmacotherapy training, in all eight medical faculties in the Netherlands. They individually indicated the level of competence students nearing graduation need to master the treatment of each disease mentioned in the specific learning objectives. They also indicated the relevance of the general learning objectives, i.e. the knowledge, skills and attitudes. A Delphi procedure was then applied to reach maximum consensus between the respondents.

Literature

In order to identify publications regarding learning objectives in therapeutics for the entire undergraduate medical curriculum, a survey of the literature published between 1980 and 1996 was performed in Medline. The following text words were used: 'curriculum', 'therapeutics OR pharmacotherapy', 'education AND students'. The search revealed 15 publications. [9;12-25] These publications also included three references through which a total of 18 publications were retrieved. [8;26;27] Two Dutch publications, found on personal title of the main researchers, were also included. [28;29]

In 14 publications elements of the medical curriculum or the effect of training methods are described. The remaining 6 publications describe the learning objectives for therapeutics for the entire undergraduate curriculum as well as the learning objectives for pharmacotherapy knowledge, skills and attitudes.[9;19;20;23;28;29] In 1990, a list of the core knowledge, skills and attitudes that every medical student should master before graduation was developed in the United States. [19;20] The list was based on consensus achieved between 40 clinical pharmacology teachers. All learning objectives were rated as equally important, and no distinction was made between the levels of mastery. In 1994, a questionnaire was developed in the United Kingdom, based on these learning objectives. [24] Clinical pharmacologists in 27 medical faculties were asked to rate on a 4-point scale the relative importance of each learning objective as element of a core curriculum. Core knowledge items were rated as important or very important, whereas core skills were rated as less important and core attitudes were of intermediate importance.

In 1993 the necessary cognitive skills for the choice and prescription of a drug treatment (table 2: 2.1–2.9) were formulated in the Netherlands. [30] A committee of Dutch pharmacotherapy teachers from all eight medical faculties incorporated the list of cognitive skills into a list of learning objectives, consisting of knowledge, skills (cognitive, communication and motor skills) and attitudes with regard to pharmacotherapy. [28] The World Health Organisation (WHO) used the list of cognitive skills to describe the process of therapeutic clinical reasoning. [31] In 1994, a list of the learning objectives for the entire undergraduate medical curriculum in the Netherlands including (pharmaco) therapy, was published, in collaboration with the Disciplinary Board for Medical Sciences of the Association of Universities in the Netherlands (in which all the Deans are represented), the Royal Dutch Medical Association, and the Ministry of Health, Welfare, and Sports. [29] In the so called 'Blueprint' the learning objectives are subdivided into specific (discipline-related) and general objectives. The specific objectives are listed according to the medical disciplines and consist of diseases and symptoms. A doctor must be able to treat 216 diseases and symptoms in clinical practice at a certain level: make the diagnosis personally or carry out the therapy personally, referring to the most common therapy for an uncomplicated illness. The general objectives describe the knowledge, skills and attitudes for mastering these tasks. Consensus among representatives of all collaborating institutes was achieved in the formulation of both discipline-related and general objectives.

Questionnaires

In 1995, two questionnaires were developed on the basis of the literature survey. The first questionnaire contained a list with specific learning objectives and the second contained the general learning objectives (see Tables 1 and 2; left hand column). It was decided to emphasise the process of therapeutic problem-solving in the description of the learning objectives and to relate these as closely as possible to the previously developed learning objectives in the Netherlands. [29] Therefore both lists were based on the Blueprint. In the Blueprint, 216 diseases and symptoms are described at the level of 'ability to carry out the therapy personally, referring to the most common therapy for an uncomplicated illness'. After omitting all diseases and symptoms with non-drug treatment, such as

surgery, the remaining 135 diseases and symptoms were classified according to the clinical disciplines.

A total of 20 pharmacotherapy general learning objectives were taken over from the Blueprint. Based on the classification of the American Council for Medical Student Education in Clinical Pharmacology and Therapeutics, these learning objectives were classified into three categories: knowledge (and understanding), skills (cognitive, communication, motor skills), and attitudes. [19] Three conditions from another Dutch publication were added: 'knowledge and understanding of clinical pharmacology' (1.2 in table 2), 'consider the individual aspects of each prescription' (6.2), 'maximise efficacy, safety, compliance' (6.3). [28] Four derived cognitive skills (5.1 - 5.4) were added by the investigators, because reference materials and clinical guidelines are gradually becoming more widely used (obligatory).

Survey

The two questionnaires were sent to the heads of the Departments of Clinical Pharmacology, Internal Medicine and General Practice in all eight medical faculties. These departments are responsible for almost all the undergraduate therapeutic training in the Netherlands.

In the first questionnaire concerning the specific learning objectives, the respondents were asked to indicate on a 4-point scale the level of competence needed by graduated medical doctors to master the drug treatment for each disease or symptom (3: highest level to 0: lowest level). Level 3 was defined as ability to choose and prescribe a drug treatment independently and professionally for any patient with the disease, level 2 as ability to choose a (standard) drug treatment for the disease, level 1 as knowledge of the drugs that can be used for treatment of the disease, and level 0 as no need to know the drugs that can be used for treatment of the disease. Level 3 indicates that graduates should be able to treat patients with these diseases at the start of the postgraduate specialisation, also because they are then legally licensed to prescribe drugs. Level 2 indicates that actual prescription of the drug still has to be learned during the postgraduate specialisation. Level 1 indicates that patients with the disease should be referred to a specialist for the drug treatment, and level 0 indicates a disease that requires superior specialist treatment.

The general objectives describe the knowledge, skills and attitudes that are necessary for a doctor to provide adequate pharmacotherapeutic care. In the undergraduate medical education an initial effort is made to achieve the goals. Instead of indicating the required levels for each general objective, the respondents were asked to indicate on a 3-point scale the relevance of the conditions for mastering drug treatment: (2) undoubtedly relevant, (1) rather relevant, (0) not relevant. Finally, the respondents were asked to add and score any relevant learning objective that was not included in both lists.

Delphi procedure

After the respondents had returned the questionnaires, a Delphi procedure was applied to reach maximum consensus about the required level for each objective on both lists. The Delphi procedure is a method used to increase agreement on an issue in several subsequent rounds. It has been proven to be successful in research on medical education as well as on clinical practice. [32;33] In the first round, for each (specific and general) learning objective the respondents scored according to the level that was required in their department. In a second round, the respondents were informed about their own initial score for each learning objective, the average score, and the score-range of the whole group. They were then asked whether they would change their score, knowing the total group response. In the third round this was repeated again. Subsequently agreement on the level of competence for each learning objective was calculated by a described kappa coefficient for categorical data. Consensus was reached if the agreement was at least 0.61. [34]

Results

All respondents completed both questionnaires and no additional learning objectives were suggested. Two respondents from two different medical faculties did not take part in the second and third round of the Delphi procedure. The results of the questionnaire concerning the specific objectives are presented in Table 1.

Table 1. Specific pharmacotherapy learning objectives. For 135 diseases the required level of competence in mastering the drug treatment is presented:
3= to choose and prescribe a drug treatment independently and professionally for any patient with the disease
2= to choose a (standard) drug treatment for the disease
1= knowledge about the drugs that can be used for treatment of the disease
0= no need to know the drugs that can be used for treatment of the disease.
In case of full agreement after the Delphi procedure (kappa coefficient >0.61) only the mode is presented;
in case of disagreement the range is also presented between brackets.

Cardiovascular disorders	Level	***Genitourinary tract***	Level	***Endocrinology, impaired metabolism***	Level
Angina pectoris	3	Genital herpes	3	Diabetes non-insulin-dependent (type II)	3
Acute myocardial infarction	3	Renal colic	3	Hypoglycaemia	3
Cardiac asthma	3	Cystitis	3	Acute gout	3
Hypertension uncomplicated	3	Urethritis	3	Hyperthyreoidism	2
Thrombophlebitis	3 (2-3)	Vaginitis, candidiasis	3	Hypothyreoidism	2
Cardiac failure	2	Vaginitis, trichomoniasis	3	Hypercholesterolemia	2
Shock: acute treatment	2	Vaginitis, gardnerella	3	Diabetes insulin-dependent (type I)	2
Deep vein thrombosis	2	Vaginitis, non-specific bacterial	3	***Infections and parasitosis***	
Intermittent claudication	2	Vaginitis, atrophic	3	Erysipelas	3
Supraventricular dysrhythmia	1	Contraception	3	Folliculitis	3
Conduction defect	1	Pyelonephritis	2	Herpes simplex	3
Postural hypotension	1 (0-2)	Prostatitis	2	Pediculosis capitis and pubis	3
Arteritis temporalis	1 (0-2)	Dysmenorrhoea	2	Flea bites	3
Pulmonary embolism	1	Premenstrual tension syndrome	2 (1-3)	Pityriasis versicolor	3 (1-3)
Accidents	Level	Nephrotic syndrome	1	Candidiasis of the skin and nails	2
Insect bite	3	***Musculoskeletal system and connective tissue***		Scabies	2
Motion sickness	3	Osteoarthrosis deformans	3	Herpes zoster	2
Allergy due to medication in proper dose	3	Myalgia (muscle pain)	3	Acute gonorrhoea, sexually transmitted	2
Anaphylaxis due to medication	3	Lumbar backache / low back pain	3	Chlamydia, sexually transmitted	2
Carbon monoxide poisoning	3 (1-3)	Rheumatoid arthritis	2	Syphilis, primairy genital	2
Drug poisoning	2 (1-3)	Olecranon bursitis	2	Enterobiasis	2 (1-3)
Heroin overdose	2 (1-3)	Osteoporosis prevention	2	Molluscum contagiosum	2 (1-3)
Alcohol overdose	2	Osteoporosis management	2 (1-3)	Salmonellosis gastroenteritis	2 (1-3)
		Tendovaginitis	2 (1-3)		

Haematological disorders	Level
Iron deficiency anaemia	3
Macrocytic anaemia (pernicious)	3 (1-3)
Gastrointestinal disorders	
Herpes labialis	3
Candidiasis of mouth/throat	3
Gastritis	3
Peptic ulcer	3
Irritable bowel sydrome	3
Constipation	3
Diarrhea: dehydration	3
Diarrhea: symptomatic	3
Glossitis	2
Reflux oesophagitis	2
Cholelithiasis	2
Obesity	2 (1-3)
Stomatitis	2 (1-3)
Crohn's disease and ulcerative colitis	1
Child bearing and neonatal period	
Puerperal mastitis	2
Cracked nipple	2
Level	2
Neonatal conjunctivitis	2

Symptoms	Level
Cough	3
Nausea and vomiting	3
Sleep disturbance	3
Pain of low intensity	3
Tension headache	3
Febrile convulsion	3
Pain of high intensity	2 (2-3)
Feeling anxious / nervous / tense	2
Diseases of skin and subcutaneous tissue	
Impetigo (vulgaris)	3
Furuncles	3
Acne (vulgaris)	3
Warts	3
Mycosis	3
Seborrhoeic eczema	3
Napkin eczema	3
Urticaria	3
Itching (pruritis)	3
Cellulitis	2
Atopic / constitutional eczema	2
Dyshidrotic eczema (intertrigo)	2
Hydradenitis supporativa	2 (1-3)
Erythema chronica migrans	1 (1-3)

Nervous system and sense organs	Level
Otitis externa	3
Acute otitis media	3
Furuncle of nose	3
Conjunctivitis	3
Blepharitis	2
Status epilepticus	2
Migraine	2
Vertigo: Ménière's disease	2
Herpes zoster oticus	2 (1-3)
Dacryocystitis	1
Keratitis	1
Iridocyclitis	1
Acute glaucoma	1
Respiratory disorders	
Pneumonia	3
Common cold	3
Hay fever (allergic rhinitis)	3
Maxillary sinusitis acute	3
Tonsillitis acute	3
Pharyngitis acute	3
Subglottic laryngitis	3
Acute laryngo-tracheitis	3
Acute bronchitis	3
Chronic bronchitis	3
Asthma: acute exacerbation	3
Asthma: management of stable disease	2 (2-3)
Lung emphysema	2

Table 2. General pharmacotherapy learning objectives. For 28 conditions concerning knowledge and understanding, skills and attitudes the relevance for mastering drug treatment is presented: 2= undoubtedly relevant, 1= rather relevant, 0= not relevant.
In case of full agreement after a Delphi procedure (kappa coefficient >0.61) only the mode is presented; in case of disagreement the range is also presented between brackets.

		Level
1.	***Knowledge & Understanding***	
1.1:	Basic principles of pharmacology	2
1.2:	Clinical pharmacology	2
1.3:	Practical aspects of prescribing drugs	2 (1-2)
1.4:	Costs of prescribing drugs	1
1.5:	Disturbing influences on prescription behaviour	1
2.	***Cognitive Skills***	
2.1:	Determine the goal(s) of treatment for the individual patient, taking all patient and disease characteristics into account	2
2.2:	Consider drug treatment versus non-drug treatment for the individual patient, taking all patient and disease characteristics into account	2
2.3:	Choose a (drug)treatment for the individual patient, taking all patient and disease characteristics into account	2
2.4:	Choose dosage form, dosage and duration of treatment for the individual patient, taking all patient- and disease characteristics into account	2
2.5:	Determine the patient information about the treatment	2
2.6:	Determine the instructions for using the drug	2 (1-2)
2.7:	Determine the time and content of evaluation of the treatment	2
2.8:	Draw conclusions on the basis of the evaluation	2
2.9:	Modify the treatment if necessary	2
3.	***Communication Skills***	
3.1:	Inform and instruct the patient clearly about the treatment	2
3.2:	Verify that the patient understood the information	2
3.3:	Write a full prescription	2
4.	***Motor Skills***	
4.1:	Prepare a drug for parenteral administration	1
4.2:	Administer a drug parenteral(ly)	2 (1-2)
5.	***Derived Cognitive Skills***	
5.1:	The use of the Dutch National Formulary	2
5.2:	The use of Clinical Guidelines	2 (1-2)
5.3:	The use of Clinical Formularies	1 (1-2)
5.4:	The draft and use of a Personal Formulary	1 (1-2)
6.	***Attitudes***	
6.1:	A critical attitude towards disturbing influences	2
6.2:	Consider the individual aspects of each prescription	1 (1-2)
6.3:	Maximise efficacy, safety, compliance	2 (1-2)
6.4:	Keep up-to-date about drugs and their developments	1 (1-2)

They show that for 68 diseases and symptoms the treatment should be mastered at the highest possible level: ability to choose and prescribe a drug treatment independently and professionally for any patient with the disease. For 37 diseases and symptoms the required level is 2: ability to choose a (standard) drug treatment for the disease, and for 9 diseases this level is 1: knowledge of drugs that can be used for treatment of the disease. For the remaining 21 diseases and symptoms, no agreement could be reached on any of the four levels.

The results of the questionnaire concerning the general learning objectives are presented in Table 2. For mastering drug treatment, it is considered to be undoubtedly relevant (level 2) to have sufficient knowledge of basic principles and clinical pharmacology, to master almost all cognitive, communication and motor skills, and to have a critical attitude towards disturbing influences. It is considered to be rather relevant (level 1) to have sufficient knowledge of the costs of prescribing drugs and of disturbing influences on prescription behaviour, and to master the motor skills for preparing a drug for parenteral administration. For the remaining 9 learning objectives no agreement could be reached for either level.

Discussion

It was the aim of this study to determine the pharmacotherapy learning objectives that medical students have to achieve at the time of their graduation, in order to develop a standard for the measurements described in the following three chapters of this thesis.

The results show that 135 diseases and symptoms are specific learning objectives of which 68 are core diseases. When they graduate, medical students should be able to master the treatment of these core diseases and symptoms at the highest possible level: ability to choose and prescribe the drug treatment independently and professionally for any patient. They should therefore, in particular, have sufficient knowledge of the basic principles of pharmacology and clinical pharmacology, master all relevant cognitive, communication and motor skills, and should also have a critical attitude towards disturbing influences causing irrational drug-prescribing, the so-called general learning objectives. For the other 67 (135-68) diseases, for which drug treatment is available, graduates should mainly have sufficient knowledge of the drugs that can be used for the

treatment, in particular in order to refer a patient to a specialist for the treatment.

Interpretation of the results

Respondents to the questionnaire represented three medical disciplines from all eight medical faculties in the Netherlands. Therefore, the relevance of several disciplines, such as ophthalmology, dermatology, paediatrics and neurology might be underestimated. The respondents from General Practice were the generalists of the 1st line and the respondents from Clinical Pharmacology and Internal Medicine were the generalists of the 2nd line. The choice was based on weighing the possibility of response from all participants instead of representation from of all disciplines, since every participant was asked to complete the whole list in order to provide a complete overview. Secondly, the list of specific learning objectives was a selection and the participants were asked to add any relevant diseases that were not included. Although no suggestions were made, it is unknown whether any relevant diseases were missed. It can also be argued that the results might have been different if more Delphi rounds and a final meeting with all respondents had been held. [35] Calculation of Cohen's kappa might underestimate the agreement in cases in which almost all of the respondents were of the same opinion. [36] In such cases the calculated proportion of expected agreement is unjustly high, and therefore the kappa of expected agreement might also be high, resulting in a coefficient that is low. The agreement between the respondents with regard to the level of the learning objectives was probably higher than presented in this study. On the other hand, one should also take into account the fact that maximum consensus is not necessarily the best outcome: "consensus is sometimes described as where everyone agrees what no one actually believes individually". [37]

In the interpretation of the results, the Dutch undergraduate and postgraduate medical training should be taken into account. At the time of this study (1995), in all eight medical faculties the undergraduate curriculum consisted of four years of pre-clinical training and two years of clinical training (clerkships). There were only slight variations in the pre-clinical training programmes, in most cases consisting of integrated block or thematic teaching and line/longitudinal training in problem-solving skills. In all medical faculties methods are currently being

developed to teach students how to solve patient problems during the pre-clinical training. The clinical period is very similar in all the medical faculties. Most of the students start with a short period of clinical skills training (approximately six weeks), followed by clinical clerkships in various clinical departments according to a rotation scheme. Several medical faculties have a final general clerkship of four to six weeks, during which the student is given more responsibility, comparable with internships in English speaking countries. After graduation, all students become general or basic doctors. This means that they are licensed by law to treat patients, but only under supervision, until they have completed their postgraduate training in a clinical discipline or in general practice. Nevertheless, postgraduate trainees frequently prescribe drugs independently.

This situation makes it somewhat difficult to determine the learning objectives for the undergraduate training. The learning objectives presented in this paper have been mainly based on the Blueprint for the entire undergraduate medical curriculum in the Netherlands, as discussed earlier. [29] These learning objectives are the entry requirements for any postgraduate training. Therefore they cover a wide range of diseases which final year medical students should be able to treat at a 'general level', taking into account various psychological and sociological circumstances.

From 1996 until 2004, three papers on learning objectives for clinical pharmacology and therapeutics have been published. In addition to the relevance of general pharmacotherapy learning objectives, core diseases are also described.[38-40] There were no major differences compared with the learning objectives described in this study.

Recommendations

The specific and general learning objectives determined in the present study can be used for revision of the medical curriculum. If necessary, learning objectives can be adapted to the local situation in other countries based on the method described in this study. They can be also be used to determine sub-levels in elements of the undergraduate curriculum, as well as in the development of training methods, for example training in the process of therapeutic clinical

reasoning. Finally, the learning objectives can be used to assess the competence of final year medical students, and the competence of pre-clinical and clinical students. In this way, curricula can be evaluated and revised, if necessary.

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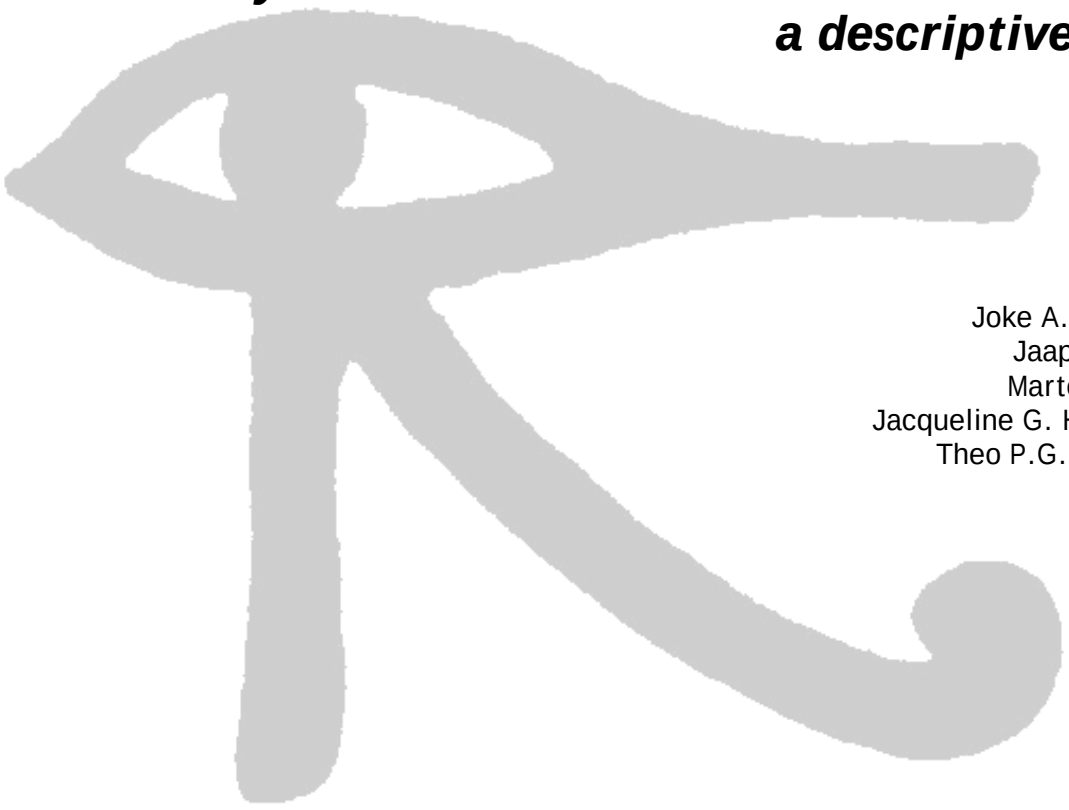
Chapter 3

The competence in pharmacotherapy of final year medical students in the Netherlands: a descriptive study



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Abstract

Aim: To evaluate whether final year medical students in the Netherlands meet the requirements as defined in the final year learning objectives for pharmacotherapy with regard to cognitive, communication and motor skills.

Methods: A survey among 80 final year medical students from all eight medical faculties in the Netherlands. The students took two tests: a Short Essay test (SE) and an Objective Structured Clinical Examination (OSCE). In the SE, three cognitive pharmacotherapy skills were assessed. For 27 written patient cases, presenting core diseases the students had to (1) choose the treatment, (2) determine the patient information or (3) take monitoring measurements. In the OSCE, based on eight patient cases, the same three cognitive skills were tested but communication and motor skills were also assessed. For eight standardized patients presenting core diseases, students had to choose the treatment, give the patient information and discuss monitoring measurements. In two cases they had to perform therapeutic motor skills by using dummies, e.g. preparing and injecting medication parenterally. The students were observed and scored directly by the observers. The three cognitive skills were assessed anonymously by independent experts from three medical disciplines of three universities: internal medicine, general practice and clinical pharmacology.

Results: The mean scores of final year medical students for mastering the cognitive skills in the SE and the OSCE were respectively 56% and 61% of the required level. For communication and motor skills in the OSCE these scores were respectively 73% and 54%, of the required level. Therapeutic errors were made in a range of 19–84% for all performances.

Conclusions: The final year medical students who participated to the tests did not sufficiently meet the requirements defined in the final year learning objectives for pharmacotherapy with regard to cognitive, communication and motor skills. The results of this study strengthened the opinion that in the Netherlands the undergraduate medical training in pharmacotherapy is inadequate.

Vollebregt JA, Metz JCM, Haan de M, Hugtenburg JG, Vries de TPGM. The competence in pharmacotherapy of final year medical students in the Netherlands; a descriptive study. Submitted

Introduction

After graduation, medical students generally start their career as qualified doctors. In most countries they are then legally permitted to prescribe drugs, though often under supervision while specialising during postgraduate training. However, little is known about the level of competence of final year medical students in choosing and prescribing drugs for patients, since this is usually assessed implicitly or theoretically during clinical examinations. Only a limited number of studies have investigated the drug prescribing behaviour of medical students nearing graduation.

In the Netherlands the undergraduate medical training programmes are reviewed once every five years. A review committee of the Association of Universities in the Netherlands (VSNU) concluded in 1992, after visiting all the medical faculties, that pharmacotherapy education was insufficient in all medical curricula.[1] Five years later it was concluded that the emphasis of the education was on basic knowledge of pharmacology and drugs. More attention should be paid to the process of choosing and prescribing drugs, and the pharmacotherapy training during the clerkships should be related to actual patients problems.[2] In a study amongst final year medical students in the Netherlands in 1990, the score for three aspects of drug prescription (choice of drug, dosage and duration) for four diseases was 50% of the required maximum.[3] In another study, performed in Australia in 1999, it was investigated whether interns could prescribe drugs appropriately for patients with four common diseases, both at the start and at the end of the internship. At the beginning of the year at least two-thirds of the interns were prescribing 'inappropriately' for all diseases, but at the end of the year 75% were prescribing 'appropriately' for the four diseases.[4] Moreover, the results of a pilot study performed in the USA in 1998 showed that the knowledge and therapeutic skills concerning over the counter medicines of 20 medical students during their family medicine clerkship was 49% of the maximum.[5] The results of several recent studies also indicate that residents make mistakes in choosing drugs and forms of dosage, in calculating drug doses, and in providing patients with information and instructions about the prescribed drugs.[6-8]

The above mentioned literature indicates that among medical students nearing graduation, the level of competence in choosing and prescribing drugs is not

sufficient. It was the aim of this study to evaluate the level of competence in pharmacotherapy of final year medical students in the Netherlands. Competence is defined as what a person is capable of doing in an observed/examination setting.[10;11] In particular it was investigated whether they met the requirements for pharmacotherapy skills and the treatment of core diseases defined in the final year pharmacotherapy learning objectives, which had been determined in our previous study.[9]

Methods

Outline of the study

In 1996, 80 final year medical students from the eight medical faculties in the Netherlands were randomly selected to participate in two tests at the VU Medical Centre (VUmc) in Amsterdam. In a written Short Essay test (SE) their cognitive skills with respect to drug treatment were assessed and in an Objective Structured Clinical Examination (OSCE) cognitive, communication and motor skills with respect to drug treatment were tested on standardized patients.

Population

From each medical faculty, 10 students were allocated to participate in the study in the penultimate week of their clerkship in general practice. This was the final regular clerkship in seven out of the eight medical faculties; for the students from the medical faculty of Maastricht, it was planned halfway through their regular clerkships. The students took the tests during their return-day in the department of General Practice in June 1996. In most faculties the return-group consisted of 10 students, but if there were more, a maximum of 10 students were randomly allocated for participation by the local faculty. The participating students were not compared to the other students in their year-class in any other way to determine whether the sample was representative. The students were informed in advance about the aim of the study, i.e. to assess their competence in pharmacotherapy. They also received instructions about the method of testing (SE, OSCE) and were told that they could use any reference materials they wished in both tests. They were not informed about the content of the tests. All 10 students of one faculty were tested on the same day, numbers

1-5 on the list started with the SE and numbers 6-10 with the OSCE. All participants received a small remuneration.

Materials

For 28 core diseases (Table 1) 28 written case-descriptions based on real patients were developed for both tests. The SE consisted of 27 cases, 7 of which were also used in the OSCE. One case was only used in the OSCE. The cases were selected according to the following criteria: pertaining to general practice, frequently occurring in clinical practice, incorporated in the list of 68 core diseases in the specific learning objectives and, if more diseases met these requirements, randomly chosen. [9] All cases were described on the basis of real patients from general practice and were carefully reviewed on content, wording and questions by two general practitioners, two specialists in internal medicine and two clinical pharmacologists. All cases had a standard design with regard to general patient information (e.g. age, gender, occupation and pregnancy), a summary of previous and current diseases and treatments (co-morbidity and medication), and an extensive description of the recent history, physical examination, results of physical and laboratory examinations, the diagnosis, and questions prompting for the essential elements of the case only. Of these cases, 15 were uncomplicated and 13 were complicated (Table 1). In complicated cases drug interactions, contraindications, pregnancy, breast-feeding or other complications were to be taken into consideration in the choice of treatment. In uncomplicated cases these factors were not present. For each case an answer key was formulated and carefully reviewed by the same experts who reviewed the cases. In addition to the specific information per case, general criteria were determined for the assessment of each cognitive skill.

For the eight cases in the OSCE a patient role was also written, including instructions for standardised patients. Each of them was trained in playing the role of one of the eight cases. Three detailed scoring lists were developed (Table 2; left hand column). The first list was for assessing the three cognitive skills: (1) choosing the (drug)treatment, (2) determining the patient information and (3) determining the monitoring measurements. The second list was for assessing the five communication skills: actually providing the information (1) explaining the effect of the drug(s) and (2) the side-effects, (3) giving instructions about the use

of the drugs, (4) verifying that the information is understood, and (5) giving the patient the opportunity to ask questions or to discuss the (drug)treatment. The third list was for assessing the two motor skills: (1) preparing a drug for parenteral administration, and (2) administering the drug parenterally. The patient roles and the scoring lists were carefully reviewed on content and wording by two general practitioners and two psychologists. During pilot sessions, the observers were trained in the use of the scoring lists and the standardized patients were trained in playing the role of a patient.

Table 1. Diseases in the 28 patient cases (15 uncomplicated and 13 complicated) in the Short-Essay test (SE), and the 8 patient cases (*) in the Objective Structured Clinical Examination (OSCE). Numbers indicate the skills assessed in the SE and OSCE: 1: choosing a treatment; 2: determining patient information; 3: determining monitoring measurements; 4: communication skills; 5: motor skills.

Diseases	**Skills**			**Skills**	
Uncomplicated	*SE*	*OSCE*	*Complicated*	*SE*	*OSCE*
Acne	3		Acute otitis media	2	
Bronchial asthma *	1	1,2,3,4	Allergy due to medication	3	
Constipation	1		Anaemia, iron deficiency	1	
Contraception	3		Atopic eczema *	3	1,2,3,4
Diarrhoea symptomatic	2		Cardiac asthma	1	
Erysipelas *	2	4,5	Cough	1	
Gout	3		Cystitis	1	
Herpes zoster	1		Endometritis	1	
Hypertension *	3	1,2,3,4	Hypoglycaemia	3	
Insect bite * (OSCE only)		4; 5	Pneumonia	1	
Pain: low intensity	2		Status epilepticus	1	
Reflux oesophagitis *	3	1,2,3,4	Trombophlebitis	2	
Sinusitis acute	1		Vaginitis, trichomoniasis *	2	1,2,3,4
Sleep disturbance *	3	1,2,3,4			
Urticaria	1				

Tests

At the start of the SE the five students received 27 case-descriptions. For 12 cases their task was to choose a (drug)treatment (table 1) . For another 6 cases the (drug)treatment was presented and their task was to determine what to tell the patient about the prescribed (drug)treatment. For the remaining 9 cases also the (drug)treatment was also presented but their task was to determine the monitoring measurements for the prescribed (drug)treatment. The students had two hours to answer the questions, after which the assessment forms were collected.

Before the start of the OSCE each of the five students was placed in one of five consultation rooms. Eight case-descriptions were laid out on the desk in a certain order. Various materials were also present in each room for patient instruction (e.g. placebo inhalers) and for parental administration of drugs (syringes, needles, flasks, dummies). For six cases the tasks were: to choose the treatment, to determine the patient information and monitoring measures, to write a prescription if a drug treatment was chosen, and to provide the patient with the necessary information and instructions about the treatment. For two cases the task was to prepare a drug for parenteral administration, to administer the drug (to a dummy) and, in one of the cases, to provide the patient with information about self-administration of the drug. Outside the consultation rooms eight standardized patients were paired to eight observers (medical doctors).

At the start of the OSCE the students had 5 minutes to read the first case-description and to prepare themselves for the consultation. Five of the eight patient-observer couples were placed in front of a consultation room in such a way that the cases presented to the students matched those of the standardized patients and the observers. The three other couples were placed in a 'waiting room'. After the 5 minutes of preparation the couples entered the consultation rooms, and the students had 10 minutes in which to perform the task(s). The couples then left the consultation room, went to the next one and waited in front of it. The fifth couple went to the 'waiting room', and one couple from the 'waiting room' went to the first consultation room. After the 5 minutes, the students were allowed for preparation, the couples again entered the respective consultation rooms. This was repeated until all the students had completed the tasks for the eight cases. Subsequently, the prescriptions made by the students and the assessment forms completed by the observers were collected.

Scoring

The answers in both the SE and the OSCE for the cognitive skill ‘choosing a (drug)treatment’ were scored by four clinical pharmacologists. For practical reasons each of them scored the answers of 25% of the students. Three general practitioners scored the answers of 33% of the students for the cognitive skill: ‘determining patient information’ and another three general practitioners scored the answers of 33% of the students for the cognitive skill ‘determining monitoring

measurements'. The scores ranged from 0 to 3 (0=no or incorrect answer; 1=disputable answer; 2=acceptable answer; 3= correct answer). The names of the students and the names of the medical faculties were masked and replaced by numbers for the scoring.

During the OSCE, all five communication skills were scored by the observers directly. The scores for three of these skills ('explaining the effect of the (drug)treatment', 'explaining the side-effects', and 'giving instructions about the treatment') ranged from 0 to 3 (0=not given; 1=given but not understandable; 2=given but only partly understandable; 3=given and fully understandable). The scores for the other two communication skills ('verifying that the information was understood' and 'giving the patient opportunity to ask questions') also ranged from 0 to 3 (0=not verified or given; 1=hardly verified or insufficiently given; 2=not explicitly verified or given; 3=explicitly verified or given).

The two motor skills 'preparing a drug for parenteral administration' and 'administering a drug parenterally' were scored by the observers directly during the OSCE on a 2-point scale: (0= no, or bad performance; 1=partly correct performance; 2=correct performance). For all cognitive, communication and motor skills, answers in the SE and performances in the OSCE that were scored as 0 or 1 were considered to be therapeutic errors.

Analysis

Mean scores were calculated as a percentage of the required scores for graduation (100%). Percentages of therapeutic errors (score 0 or 1) were calculated as a percentage of the total number of answers or performances. The Pearson correlation coefficient was used to analyse the relationship between the score for the cognitive skills in the SE and the OSCE. The Student's *t*-test was used to analyse differences between the SE cognitive skills score of the students who started with the SE and the students who started with the OSCE. $P<0.05$ was considered to be statistically significant.

Results

76 (95%) and 66 (83%) final year medical students completed the SE and the OSCE respectively; 10 students from the UMCU (Utrecht) did not arrive at the prearranged time, so they only completed the SE. The results of the SE and the

OSCE are presented in Table 2. The overall mean score for the three cognitive skills in the SE and the OSCE were 55.8% and 60.7% of the required score for graduation, respectively. There was a slight relationship between the scores for the cognitive skills in both tests (Pearson correlation coefficient: r=0.36, n=66, p<0.028).

There were no significant differences between the scores of the students who started with the SE and those who started with the OSCE.

In the OSCE the scores for 'choosing a treatment' and 'determining monitoring measures' were significantly higher than in the SE (72.6% vs 63.3% and 66.0% vs 52.9%); for 'determining patient information' the score at the SE was significantly higher (43.6% vs 51.3%).

The percentage of therapeutic errors for these skills was 27.7% for uncomplicated cases, and 50.4% for complicated cases in the SE and 37.6% and 32.1% respectively, in the OSCE.

With regard to the choice of drug in all cases (uncomplicated and complicated) in the SE, in 31.4% of the cases the wrong drug was chosen, in 18.6% the wrong form of dosage, in 29.1% the wrong dosage and in 30.0% the wrong number of drugs was prescribed. For the OSCE the figures were respectively 13.9% (drug choice), 20.0% (form of dosage), 26.5% (dosage) and 39.4% (number of drugs). Detailed information can be found in Table 2.

The overall mean scores for communication and motor skills were 73.0% and 53.5% of the required score for graduation, respectively. The percentages of therapeutic errors for these two skills were 18.6% and 84.1%, respectively.

Between the students from the different universities, the range in the score of the SE was from 41.0% - 57.3% of the maximum, and for the OSCE from 56.7% - 60.7% of the maximum. For all students the range in score was 35.4% - 77.2% for the SE and 46.7% - 80.0% for the OSCE.

Table 2. Assessment of the competence in pharmacotherapy skills of 66 and 76 final year medical students in an Objective Structured Clinical Examination (OSCE) and a Short Essay test (SE). Presented are the mean scores and confidence intervals (CI) of the skills as a percentage of the required level for graduation. Also presented are the percentages of therapeutic errors (score 0-1) for the uncomplicated and complicated patient cases in both SE and OSCE.

	Skills (Mean % (CI))		**Therapeutic error** (Mean %)	
			Uncomplicated / complicated cases	
PHARMACOTHERAPY SKILLS	**OSCE** (n=66)	**SE** (n=76)	**OSCE** (n=66)	**SE** (n=76)
Cognitive skills (score 0-3)	**60.7 (59.5-61.9)#**	**55.8 (54.7 – 56.9)**	**37.6 / 32.1**	**27.7 / 50.4**
Choosing a treatment	72.6 (71.4-73.8)#	63.3 (60.8 - 65.8)	36.5 / 27.9	15.5 / 55.0
Determining patient information	43.6 (42.3-44.9)	51.3 (48.4 - 54.2) #	21.7 / 21.4	36.8 / 31.6
Determining monitoring measurements	66.0 (64.7-67.3)#	52.9 (50.2 - 55.6)	54.6 / 46.9	30.7 / 64.5
Communication skills (score 0-3)	**73.0 (71.1-75.0)**		**18.6**	
Giving information about effect of the treatment	74.0 (71.7-76.3)		24.0	
Giving information about side effects	62.7 (60.7-64.7)		36.1	
Giving instruction about the treatment	83.7 (82.0-85.4)		12.2	
Verifying that the patient understood the information	67.0 (66.1-67.9)		14.6	
Giving the patient opportunity to ask questions	77.6 (76.4-78.8)		6.0	
Motor skills (score 0-2)	**53.5 (52.3-54.7)**		**84.1**	
Preparing a drug for parenteral administration	58.0 (56.5-59.5)		83.5	
Administering the drug parenterally	49.0 (46.8-51.2)		84.6	

= significant difference between OSCE and SE ($p<0,05$).

Discussion

To our knowledge, the present study was the first in which the level of competence in pharmacotherapy skills among) medical students nearing graduation was extensively investigated. The results showed that in 1996 the participating students scored approximately 40%, 30% and 50% below the required level for graduation for pharmacotherapy cognitive, communication and motor skills, respectively, and that many therapeutic errors were made in complicated cases. These results should be interpreted with care, taking into account the generalisation of the results and the validity and reliability of the tests.

Generalization, validity, reliability and feasibility

A participation of 5% of the medical students who graduate annually was low. Although they were selected randomly from eight different medical faculties in the Netherlands, it may be questioned whether the results can be generalised. However, medical doctors cannot permit themselves to make errors in the treatment of patients, so the level of competence in pharmacotherapy skills of all medical students with regard to the core diseases, should be 100% on graduation. This also applies to the participating students.

In general, the validity and reliability of the SE and the OSCE is considered to be relatively high, in particular in the assessment of skills.[12-14] To our knowledge there is no specific information available with regard to the validity and reliability of these tests for pharmacotherapy skills, i.e. cognitive, communication and motor skills. The validity and reliability depends, among other things, on the content and number of cases in the SE and in the OSCE, respectively.

The following three aspects contributed to the *validity* of the two tests. First, with 27 carefully selected core diseases (40% of the specific learning objectives), the SE was considered to be a good reflection of the specific learning objectives. The inclusion of so many core diseases was possible on the basis of the so-called 'key-feature' concept.[15;16] In each case only the most relevant cognitive skill was assessed, and therefore more cases could be incorporated. Secondly, the practical setting of the OSCE was similar to that in which the actual work was carried out by 6th year medical students in their clerkships. Finally, it has

recently been shown that the standardised procedure for writing the case-descriptions for both the SE and the OSCE contributes to greater test validity.[17]
The *reliability* of a test determines the extent to which the results can be generalised to the entire domain, and mainly depends on the length and content of the test and the reliability of the assessment.[13] In a test, only a part of the domain can be assessed, because otherwise the test would be very time-consuming. Therefore, in a test the problem of case-specificity, i.e. the variability in a student's performance across all cases, affects the reliability. In the present study the following favourable measures were taken to improve the reliability. The level of competence in pharmacotherapy was measured in a SE and an OSCE. These two tests were complementary to each other. The SE only assessed cognitive skills, whereas the OSCE assessed all skills.[14;18] Another contribution to reliability was the inclusion of many cases as possible, based on the key-feature concept, in order to reduce the case-specificity.[19;20]
Unfortunately, the reliability of the scores is unknown, since it was not possible to investigate whether there were differences in scores between the assessors (inter-rater agreement) and differences in two separate scores made by the same assessor (intra-rater agreement). The assessors of the SE were volunteers, and therefore a time consuming second assessment was not performed. Instead, it was decided to involve 10 different assessors in the assessment of all students, and each student was assessed by at least three assessors. The eight assessors of the OSCE each observed a station instead of having two assessors to observe four stations, since the reliability of the OSCE is improved including more stations instead of more assessors for each station.[13]
With regard to the *feasibility*, there were several restrictions. The students had to travel to the VUmc and therefore 4 hours was the maximum time for the tests. For financial reasons the number of students from each medical faculty was limited to 10. If more students had participated, more standardized patients would be needed for the OSCE at greater expense. Finally, assessment of the cognitive skills of 80 students already was an enormous task.

Remarkable findings

Two remarkable findings will be discussed below. The first is that with regard to the cognitive skill 'choosing a treatment' the students performed better in the

OSCE than in the SE. This may be due to the setting of the OSCE, which was more similar to real clinical practice than the written SE. After all, these final year medical students had just finished working for two years in clinical practice during their clerkships. This is supported by the finding that the scores for the communication skills in the OSCE were rather high (average 73.0%) and the percentage of therapeutic errors rather low (18.6%). The difference may also be caused by the fact that the OSCE contained six uncomplicated and two complicated patient cases whereas in the SE the ratio was 15:13.

The second remarkable finding was that with regard to the cognitive skill 'to determine what to tell the patient' the students performed better in the SE than in the OSCE. In both tests the students could consult reference materials. There are two explanations for this finding. Firstly, in the SE the students were asked explicitly to write down what they would tell the patient. In the OSCE it was inherent in the communication, and not explicitly asked. Secondly, in the OSCE the students had to combine 'determining what to tell the patient about the treatment' with actually 'giving information and instructions in understandable language'. The latter task was obviously more difficult because the students also had to make use of their communication skills. The result was that many students gave incorrect information to the patient in understandable language.

Steps of therapeutic competence

Both above-mentioned findings might indicate that there is, indeed, a difference between the following three steps of therapeutic competence: 'knowing the best treatment for the disease', 'knowing how to choose the best treatment for an individual patient with the disease', and 'actually choosing and prescribing the best treatment for a patient with the disease'. At first sight, the initial step appears to be simple: textbooks, formularies, compendia, drug committees, teachers, colleagues and many other sources provide information about the best treatment(s) for each disease. In principle, this information can be memorised and used in practice. However, at second sight this is less easy than it appears to be because these sources often suggest different treatments for the same disease. This is due to various factors, such as the availability of the treatment, the application of different selection criteria and the different values given to each criterion, personal clinical experience, influence from and dependency on

the pharmaceutical industry, budgets made available by governments and hospitals, and reimbursement by insurance companies. This is a hurdle that pre-clinical medical students have to take when they start their clinical clerkships. They experience that the knowledge about treatment they have gained from books (if it has not been forgotten, as is frequently the case) is often different from the treatment that is prescribed in hospitals, outpatient clinics and general practice. Therefore, instead of 'knowing the best treatment for the disease', students should learn 'how to choose the best treatment for the disease'. In other words, they have to learn how to use the information that can be obtained from all the different sources mentioned above. The WHO enforces this in the student manual 'Guide to Good Prescribing' by describing how to select standard (drug)treatments and how to develop a 'personal formulary'.[21] This provides students with awareness of the cognitive process of selecting and choosing drugs and the relative value of selection criteria. This also explains to them why no golden standard treatment exists, and why standard treatments frequently differ and change.

The manual also provides the basis for the second step: 'knowing how to choose the best treatment for an individual patient'. In general practice, patients cannot always be treated according to the standard treatment. In outpatient clinics and hospitals there are probably more complicated cases requiring other treatment than the standard treatment. Therefore students have to learn how to choose a treatment taking the patient's personal and clinical characteristics into account. This is especially important because in daily practice they will have to master the third step: 'actually prescribing the treatment for a patient with the disease'. Then they will have to combine the cognitive process of choosing the treatment with communication and negotiation with the patient about the treatment.

Conclusion and recommendations

Despite the limitations and considerations mentioned above, the results of this study strengthen the opinion that in 1996 the competence of medical students nearing graduation in the Netherlands did not meet the requirements defined in the final year learning objectives with regard to pharmacotherapy skills. It has been argued that inadequate undergraduate teaching was probably one of the reasons. Too much emphasis was laid on 'learning what (drug)treatment to

prescribe' instead of 'learning how to choose and prescribe a (drug)treatment'. Based on the results of this survey, it was recommended to develop, implement and evaluate new ways of teaching and learning pharmacotherapy. Training in choosing and prescribing (drug)treatments simultaneously with gaining factual knowledge about drugs and non-drug treatments, might contribute to a higher level of competence in pharmacotherapy skills, in particular during the pre-clinical period. This would enable students to use the knowledge immediately within the context in which it has to be applied: choosing and prescribing (non-) drug treatments for individual patients. It has been shown that in diagnostic problem-solving this way of integrated learning is more effective than so-called sequential learning when knowledge is learned first and later applied.[22-24] It is recommended that this teaching method should be followed by explicit training and experience in choosing and prescribing drugs in a clinical setting, including frequent monitoring, supervision and feedback from staff members.

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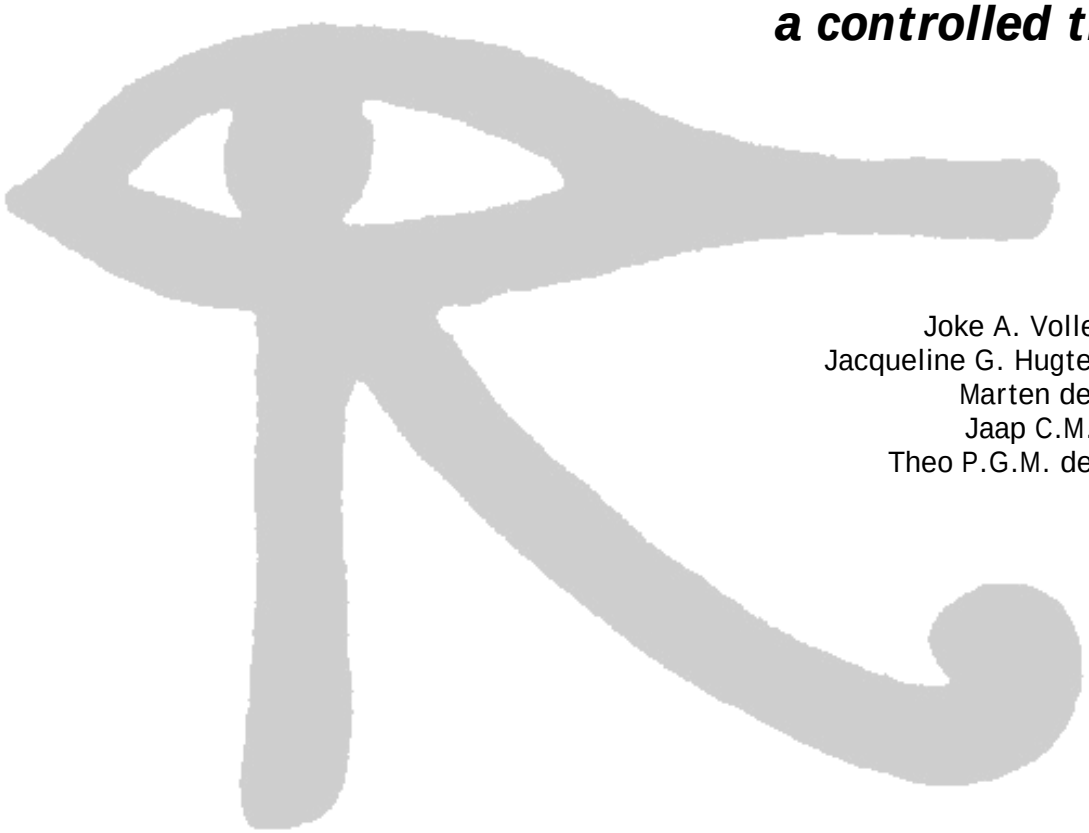
Chapter 4

The ability of pre-clinical medical students to learn cognitive pharmacotherapy skills; a controlled trial



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Abstract

Aim: To determine whether pre-clinical medical students are able to learn cognitive pharmacotherapy skills, i.e. choosing a (drug) treatment, determining patient information and taking monitoring measurements, simultaneously with gaining the necessary pharmacology and pharmacotherapy knowledge.

Methods: A controlled study based on a pre-test/post-test design among 85 3rd year pre-clinical medical students from two medical faculties in Amsterdam. The students were randomly divided into a study group and a control group. The intervention programme was a copy of the obligatory training in pharmacotherapy skills for 5th year students. Before and immediately after the training both the study group and the control group took a test, and nine months later they took another test. In the tests the level of knowledge, and cognitive skills (choosing a [drug] treatment, determining patient information and monitoring measurements) were assessed. As a reference group the 5th year students also took the tests.

Results: Before the training there was no difference between the levels of the cognitive skills in the 3rd year study group and control group: 26.7% and 27.4% of the required level for graduation, respectively. Immediately after the training the level in the study group had increased significantly (46.0%), and showed no significant decline on the second post-test nine months later (41.3%). The control group scored significantly lower on these two post-tests: 36.7% and 36.3% respectively. There were no differences between the study group and the control group in the level of knowledge in any of the three tests (52.8/53.3%, 69.1/66.4% and 55.0/55.7% of the maximum respectively).

The level of cognitive skills in the 5th year reference group before and after their obligatory training was 40.3% and 44.5%, respectively. The level of knowledge increased significantly from 48.8% of the maximum before the training to 68.0% after the training.

Conclusions: Pre-clinical medical students seem to be able to learn pharmacotherapy cognitive skills simultaneously with gaining pharmacology and pharmacotherapy knowledge. Clinical students, who mainly gain knowledge of drugs during their pre-clinical years, might experience problems with learning cognitive pharmacotherapy skills because this knowledge might have gone rusty since then.

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Introduction

It is generally believed that applying knowledge, for example, in problem-solving is almost impossible if this knowledge has not yet been acquired. Therefore, most curricula start with a period of gaining knowledge, followed by a period of learning to apply this knowledge. The rather sharp distinction between the pre-clinical and the clinical phase is also a reflection of this so-called sequential learning. More specifically, this is illustrated by teaching the basic principles of pharmacology and properties of drugs in the pre-clinical phase, followed by training in the choice and prescription of drugs in the clinical phase.

However, in recent decades various changes have been implemented in the curricula of primary and secondary schools, universities, and consequently medical faculties. These changes vary considerably. In some medical faculties the teaching of clinical subjects has been moved to an earlier stage in the curriculum, and pre-clinical subjects postponed until the clinical years, for example a course in clinical pharmacology during the final clinical year. In other faculties the curriculum integrates pre-clinical teaching of basic and clinical subjects, longitudinal teaching of problem-solving simultaneously with gaining knowledge. Other curricula are complete problem-based like the medical curricula of McMaster University in Canada, and the University of Maastricht in the Netherlands).

All these changes are mainly based on the growing evidence that gaining knowledge along with applying knowledge is more effective than sequential learning.[1;2] The greater effectiveness of gaining knowledge simultaneously with learning to apply the knowledge, is explained by theories originating from cognitive psychology and medical problem-solving.[3-6] The way knowledge is stored in the memory determines to a great extend the availability of the knowledge when it has to be recalled or applied. If the knowledge is gained simultaneously with solving patient problems, it will be stored in combination with the problems for which it has to be applied. When the student has to solve such patient problems, for example in clinical practice or in a clinical examination, the knowledge is recalled much more accurately and rapidly.[7]

Theories of cognitive psychology explain this by showing that (diagnostic) problem-solving is mainly based on recognition of previous experience of cases

which are similar.[1] By frequently solving problems, doctors gradually generate so-called networks of organised knowledge in their memory. More exposure to patients and thus increasing experience, leads to condensation of these networks into easily accessible (illness) scripts. These scripts contain clinically relevant information about diseases, their consequences, and the context under which they develop. Then, based on recognition, the doctors are able to choose the right script for solving a specific problem efficiently.[5] These theories are based on studies of mainly diagnostic problem-solving. However, little is known about the effect on pre-clinical students of simultaneously learning therapeutic problem-solving and gaining pharmacology knowledge.

Therefore, it was the aim of the present study to determine, in a controlled intervention study, whether pre-clinical students are able to learn the cognitive pharmacotherapy skills, i.e. choosing a (drug) treatment, determining patient information and determining monitoring measurements, simultaneously with gaining the necessary pharmacology and pharmacotherapy knowledge.

Methods

Study design

A controlled intervention study with a pre-test/post-test design was performed. In addition to the normal sequential learning programme, a study group of 3rd year pre-clinical medical students received the same training in cognitive pharmacotherapy skills as 5th year clinical students. Before (T0), immediately after (T1) and again nine months after the training (T2) their pharmacology and pharmacotherapy knowledge and cognitive pharmacotherapy skills were tested. A control group of 3rd year students only participated in the tests. A reference group of 5th year clinical students took the same tests before and immediately after their obligatory training (T0,T1).

Population

In 1997, 90 3rd year medical students (45 students from the both VUmc and 45 students from the AMC-UvA) participated voluntarily in the study in return for a small remuneration. The students were recruited by announcements and calls after lectures. Only students who had passed the 2nd year examinations were included. The scores of the participating students from the VUmc were compared

to those of the rest of their class on the pharmacology examination to determine whether the volunteers were comparable to their peers. The mean score of the participating students did not differ from that of the other 3rd year students. Unfortunately, no such data were available for the students from the AMC-UvA.
All students were informed in advance about the aim of the study and the method of testing. They were allowed to use their own reference materials during the tests. After the pre-test (T0), based on the preliminary results of the knowledge test, a stratified randomisation (high, moderate and low score) of the 90 students took place. 45 Students were allocated to the study group, and 45 to the control group. 'Cross-contamination' of the students in the study group and the control group was prevented by giving the students in the control group the opportunity to participate in the training after T2, and by explaining the importance of not exchanging any information. The students in the study group from both universities were sub-divided into two small groups, 11 students in each VUmc group and 11 and 12 students in the AMC-UvA groups. At each university the two groups received the training from one clinical pharmacologist.
For the reference group of 5th year students the training was obligatory during their first clerkship (15 students at the VUmc and 23 students at the AMC-UvA). Therefore, it was not possible to create a control group.

Undergraduate medical curriculum of participating universities
In both medical faculties the undergraduate medical curriculum was very similar, and based on sequential learning. It consisted of a pre-clinical phase of four years, followed by clinical clerkships for two years. The pre-clinical phase mainly consisted of thematic blocks regarding certain organ systems. In each block the students were taught knowledge of anatomy, physiology, pathophysiology and clinical features, including pharmacology and the drugs to treat the diseases of that system. Simultaneously, in about 10% of the total study-load, the students learned in small groups to apply the previously gained knowledge to solve patient problems. During this problem-solving training the emphasis in the 1st and 2nd year was on history-taking and physical examination, and in the 3rd year on additional tests, such as X-rays and laboratory analysis, respectively. In the 4th year the emphasis was on therapy, including pharmacotherapy.

After the pre-clinical years the 5th year students entered the 2-year clinical clerkships, starting with a 6 weeks clinical skills training, including therapeutic skills. A copy of this training was used for the intervention in the 3rd year (see below). The clinical skills training was followed by clinical clerkships of two to twelve weeks at all major clinical departments and in general practice.

Training (intervention)

The training programme consisted of four plenary sessions of two hours a week, and approximately two hours of self-study each week. Before the start of the programme, but after the pre-test (T0), the students in the study group were provided with information about the learning objectives, treatment guidelines for four core diseases (essential hypertension, pneumonia, bronchial asthma and diabetes non-insulin-dependent (type 2)), the Dutch National Formulary, four written case-descriptions on the basis of real patient problems for each core disease, and with the World Health Organisation (WHO) Guide to Good Prescribing. [8] The four core diseases are included in the final year *specific learning objectives*. [9]

The *general learning objectives* were: the ability to choose a (drug)treatment, to determine patient information about the (drug) treatment and to determine monitoring measurements for evaluating the effect of the (drug) treatment.

The *treatment guidelines* were derived from the Dutch College of General Practitioners and from other sources [10-13]. The Dutch National Formulary contains relevant information about all the drugs that are available in the Netherlands, including advice on the choice of drug(s) for a certain disease.

For each of the four core diseases four written *case-descriptions* were formulated according to a standard design: general patient information (e.g. age, gender, occupation and pregnancy), a summary of previous and current diseases and treatments (co-morbidity and medication), and an extensive description of recent history, physical examination, results of physical and laboratory examinations and the diagnosis. For each disease the cases differed with regard to the seriousness of the disease and complications such as age, co-morbidity and medication, drug allergy, pregnancy, and breast-feeding.

The *WHO Guide to Good Prescribing* provides medical students with a six-step approach to pharmacotherapy. These steps are:

- (1) define the patient's problem
- (2) specify the therapeutic objective
- (3) choose a (drug) treatment, taking all relevant patient characteristics into account
- (4) start the treatment and/or write the prescription in case of a drug treatment
- (5) give patient information and warnings
- (6) take monitoring measurements.

One of the key principles of the WHO approach is to divide step 3 into two parts: first consider your *p*-(drug) treatment (*P*ersonal (drug) treatment choice) for the disease in general (step 3a), and then verify its suitability for the patient in question and alter the (drug)treatment if necessary (step 3b). For determining the p-(drug) treatment the Guide also provides a step-by-step approach: (1) define the diagnosis, (2) specify the therapeutic objective, (3) make an inventory of effective groups of drugs, (4) choose an effective group according to criteria, (5) choose a p-drug. Finally, one or more p-drugs can be incorporated into p-treatments.

Before the first session the students had to read the WHO Guide to Good Prescribing and the treatment guidelines for essential hypertension.
In the first session the learning objectives and the programme were explained and any questions the students asked about the Guide were answered. Subsequently, following the step-by-step approach of the Guide, the p-(drug) treatment for essential hypertension was discussed. Then, the choice of treatment for the four case-descriptions of essential hypertension was discussed. At the end of the first session the students received homework assignments for the second session: determine a p-(drug)treatment for pneumonia, and choose the treatment for the four case-descriptions of pneumonia. In the following three sessions the p-(drug) treatment and the treatment choice for the case-descriptions were studied and discussed in the same way for pneumonia, bronchial asthma and non-insulin-dependent diabetes.

A clinical pharmacologist, who was instructed to facilitate the learning process and to stimulate the students to work out step-by-step the solutions for the choice and prescription of drugs, supervised each sub-group of students. He was instructed not to provide solutions for the patient problems.

Tests

The aim of the pre-test, post-test, and 9-month post-test (T0,T1,T2) was to determine the level of competence in three cognitive pharmacotherapy skills, i.e. choosing a (drug) treatment, determining patient information and taking monitoring measurements, and the level of knowledge concerning drugs. These skills are necessary for treating a patient with any type of core disease. Therefore, it had to be avoided that the tests only measured what had been taught during the training with regard to the four core diseases and case-descriptions. For that reason, 21 core diseases were selected, including the four in the training. The selection criteria were: the diseases were, as much as possible, proportional to the list of 68 core diseases[9] and all diseases had been discussed already in the thematic blocks of the 2nd and 3rd year, so that the students were familiar with the pathophysiology. 21 case-descriptions were written, based on the 21 core diseases and on real patient's problems, and carefully reviewed on content and wording by a general practitioner and a specialist in internal medicine from each of the two medical faculties. Two measurements minimised the testing effect of T0 on T1, and of T1 on T2. Each test consisted of seven cases. T0 included no cases with intervention diseases. In T1 two cases with two of the intervention diseases were randomly included, and T2 included two cases with the other two diseases. All other cases were randomly divided over the three tests. The students were not informed about the answers after any of the tests.

The three tests (T0,T1,T2) consisted of two parts: a skills test and a knowledge test. The knowledge test consisted of 40 multiple-choice questions (MCQs) of the true-false type. The questions were derived from examinations of the thematic blocks in the two medical faculties. Questions were only chosen if they met the faculty criteria for reliability. The students had 1 hour in which to answer the questions.

In the skills test, seven written case-descriptions were presented, each with a different disease. The format of the cases was the same as that used during the training. Each case-descriptions was followed by a standard open question (SOQ) on: how to choose a (drug) treatment (three cases), or how to determine the patient information about the chosen (drug) treatment (two cases), or how to determine the monitoring measurements for evaluating the effect of the (drug) treatment (two cases). In the latter four cases, a plausible (drug) treatment was presented. The students had 1 hour in which to answer the questions. They could use their reference materials during the test, but were not allowed to use the training materials, or to consult each other or the supervisor.

For the evaluation of the study-load and their opinion about their ability to solve pharmacotherapeutic patient problems, a questionnaire was developed for the 3rd year students in the study group and the reference group of 5th year students. They were asked to mark on a 5-point scale (1: absolutely disagree – 5: absolutely agree) the extend to which they could solve pharmacotherapeutic patient problems independently with regard to the core diseases and other diseases, and their ability to handle patient problems systematically. They were also asked how much time they had spent on preparation for each session and their opinion about the degree of difficulty (too easy; appropriate; too difficult) of the pharmacotherapy training programme.

Scoring and analysis

Analysis of the answers to the knowledge test was performed electronically.

With regard to the skills test, for each case all the different types of (drug) treatment or patient information or monitoring measurements were registered on overall scoring sheets, with a code for the identity of the students, the study year (3rd or 5th), the tests (T0,T1,T2), the study group and the control group. For each case-description an answer key was formulated and carefully reviewed by four experts: two general practitioners and two specialists in internal medicine from the two medical faculties. In addition to the specific information per case, general criteria were determined for the assessment of each cognitive skill. The answers were scored by the four experts, who were instructed to score at the level used for the final year learning objectives [9] and not to consult each other. The answers were scored on a 4-point scale (0 = no or incorrect answer, 1 =

disputable answer, 2 = acceptable answer, and 3 = correct answer). Scores for each SOQ were calculated as the mean of the scores given by the four experts. Unfortunately it was not possible to measure the inter or intra-rater reliability between the experts or to achieve consensus between the four experts about the score for each answer either in a consensus meeting or by means of a written Delphi procedure. The voluntarily participating experts felt that this would be too time-consuming. All differences were analysed by means of Students' two-tailed *t*-test. $P<0.05$ was considered to be statistically significant.

Results

A total of 85 3rd year students (95%) in the studygroup and the control group (43, 42) participated in all three tests (T0,T1,T2) and all 5th year students (38) participated in T0 and T1. Only 5 3rd year students were unable to participate at T2 because of study reasons. There were no differences between the scores of students from the two different medical faculties. The results are presented in Figure 1 and Table 1 as a percentage of the required score for graduation, as previously determined in the learning objectives.

At T0 there were no differences between the scores in the study group and the control group for either therapeutic cognitive skills or knowledge.

With regard to the cognitive pharmacotherapy skills, the level of the overall scores in the study group increased significantly from 26.7% for the pre-test (T0) to 46.0% for the first post-test (T1). After nine months (T2) the level had dropped to 41.3%, but was still considerably higher than the score for the pre-test (T0). Furthermore, the scores in the study group for both post-tests (T1 and T2) were significantly higher than those in the control group. The increase in the overall scores in the study group for T1 and T2 was mainly due to two of the three cognitive skills: 'choosing a treatment' and 'determining monitoring measurements' (Table 2). The scores in the study group for these two cognitive skills of were also substantially higher than those in the control group. This difference was not found for the skill 'determining patient information'.

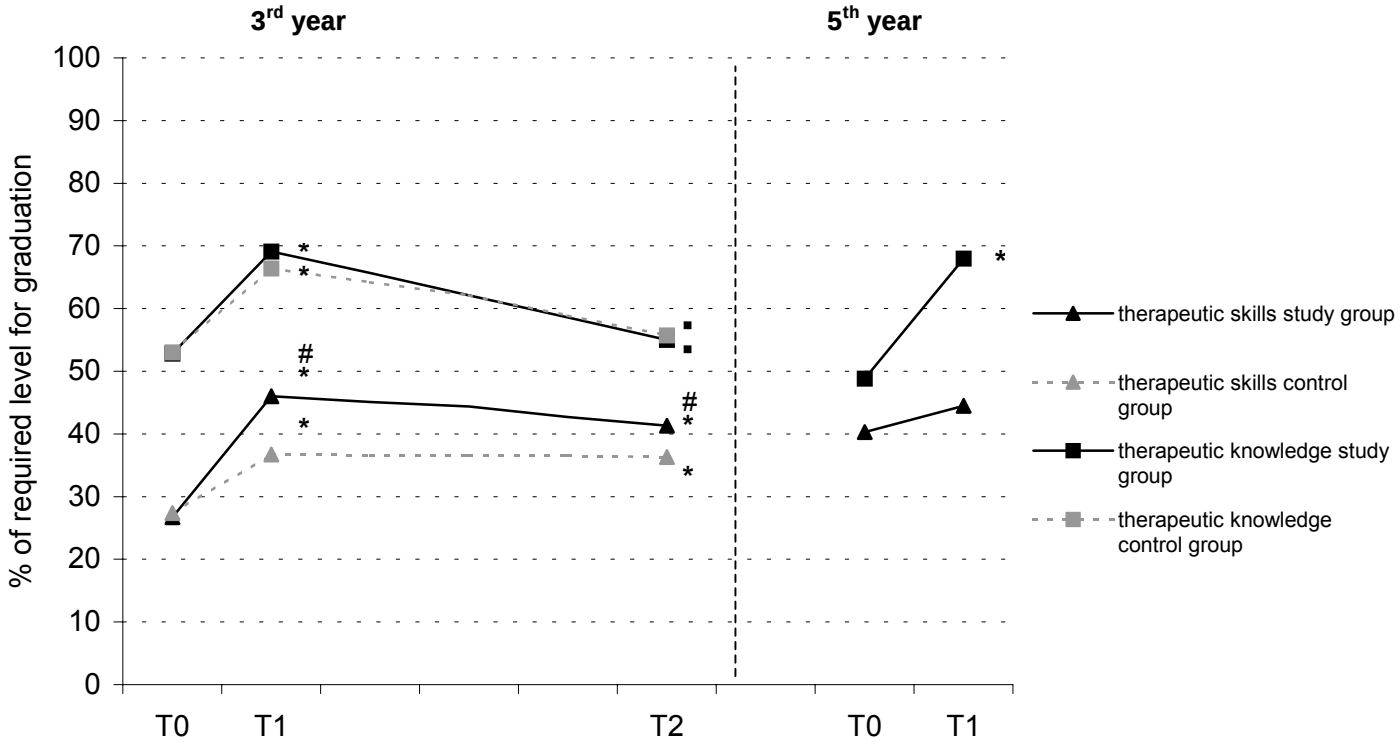

Figure 1.
Results of a randomised controlled pre-test/post-test intervention study. Before, directly after, and nine months after the training the 3rd year medical students took a test to assess their therapeutic knowledge and cognitive skills (T0,T1,T2). The control group just took the tests. The 5th year students all received the training and took the T0 and T1 test. Presented are the mean scores as % of the required level for graduation.
*: significant difference compared with T0 ($p<0.05$)
▪: significant difference compared with T1 ($p<0.05$)
#: significant difference compared with the control group ($p<0.05$)

The level of the overall scores for the cognitive skills in the 5th year reference group increased only slightly, but not significantly from 40.3% at T0 to 44.5% at T1. At T1 the level of the overall scores in the 5th year reference group did not differ from the scores at T1 and T2 in the 3rd year study group.

With regard to the knowledge test, the level of the scores in the 3rd year study group increased significantly from 52.8% at T0 to 69.1% at T1. After nine months (T2) the level had decreased to 55.0%. These scores did not differ from those in the control group.

Table 1. Results of 3rd year pre-clinical students. Presented are the mean scores as % of the required level for graduation plus the 95% CI. The study group received the same training in cognitive therapeutic skills as the obligatory training for 5th year clinical students.

	3rd year		4th year	5th year reference group	
	T0	T1	T2	**T0**	T1
Study group: n =	**43**	**43**	**43**	**38**	**38**
Control group: n =	*42*	*42*			
Cognitive therapeutic skills	**26.7 (23.9-29.6)**	**46.0 (43.1-48.6) # ∗**	**41.3 (38.8-43.8) # ∗**	**40.3 (36.6-44.0)**	**44.5 (40.6-48.4)**
	27.4 (24.4-30.4)	*36.7 (33.7-39.6) ∗*	*36.3 (33.8-38.7) ∗*		
choosing a (drug)treatment	**33.5 (27.9-39.1)**	**60.2 (55.3-65.2) # ∗**	**50.4 (45.1-55.7) # ∗ ▪**	**57.7 (51.0-64.5)**	**57.5 (51.5-63.5)**
	33.4 (28.2-38.6)	*40.3 (35.0-45.7) ∗*	*43.3 (38.1-48.4) ∗*		
determining patient information	**13.8 (10.1-17.5)**	**30.5 (26.8-34.3) ∗**	**32.0 (29.3-34.7) ∗**	**22.4 (19.2-25.6)**	**28.5 (23.8-31.3) ∗**
	15.6 (12.2-19.0)	*28.9 (26.0-31.8) ∗*	*28.6 (25.5-31.6) ∗*		
determining monitoring measurements	**36.0 (32.5-39.4)**	**47.8 (44.3-51.3) # ∗**	**42.5 (37.8-45.2) ∗ ▪**	**41.1 (36.9-45.2)**	**50.4 (45.1-55.7) ∗**
	36.2 (32.2-40.2)	*42.9 (39.6-46.1) ∗*	*37.4 (33.1-41.7) ▪*		
Similar cases (retention)		**40.0 (36.3-43.6) #**	**38.8 (34.4-43.1)**		**37.6 (32.9-42.3)**
		29.9 (25.7-34.1)	*34.0 (30.6-37.4)*		
Other cases (transfer)		**48.8 (44.6-52.6) #**	**42.5 (39.6-45.4)**		**45.6 (41.1-50.1)**
		39.9 (36.4-43.3)	*37.6 (34.6-40.6)*		
Therapeutic knowledge	**52.8 (49.7-55.9)**	**69.1 (66.1-72.0) ∗**	**55.0 (53.0-56.9) ▪**	**48.8 (45.6-51.9)**	**68.0 (64.1-71.9) ∗**
	53.3 (49.7-56.9)	*66.4 (63.7-69.2) ∗*	*55.7 (53.5-57.9) ▪*		

#: significant difference compared with control group ($p < 0.05$)
∗: significant difference compared with T0 ($p < 0.05$)
▪: significant difference compared with T1 ($p < 0.05$)

The scores for the knowledge test in the 5th year reference group increased significantly from 48.8% at T0 to 68.0% at T1. The scores in the 5th year reference group did not differ from the scores in the 3rd year study group and control group for either test. For both the 3rd year study group and the 5th year reference group there were small differences in the score for the cases similar to those of the intervention diseases and those who were different.

The questionnaire revealed that the 3rd year students were of the opinion that they could solve pharmacotherapeutic patient problems independently at 74% of the maximum possible score for the four diseases in the intervention, and at 70% for other diseases. For the 5th year reference group these figures were 76% and 70%, respectively. The 3rd year students scored 74% for their ability to handle patient problems systematically, whereas the 5th year students scored 62%. The 3rd year students spent two to three hours preparing for each session, while the 5th year students spent less than two hours. All 3rd and 5th year students were of the opinion that the level of the training programme was appropriate.

Discussion

The aim of the study was to determine whether pre-clinical medical students are able to learn cognitive pharmacotherapy skills, i.e. choosing a (drug) treatment, determining patient information and taking monitoring measurements, simultaneously with gaining pharmacology knowledge.

The level of pharmacology knowledge and the level of mastering cognitive pharmacotherapy skills increased significantly in all participating students. However, the increase in the level of therapeutic cognitive skills in the students who participated in the training (study group) was significantly greater than the increase in the control group. There was no difference between these two groups with regard to the level of knowledge.

Generalisation, validity, reliability and feasibility

The 85 students from two different medical faculties represented approximately 20% of the total number and they were volunteers. Therefore, generalisation to the entire study year class or to students in other faculties may be questionable. However, the students from the VUmc did not differ from the other students in their year in the results of another pharmacology examination. Moreover, the

students were randomly allocated to the study group or the control group. Finally, the students from both faculties participating in this study followed a more or less sequential type of curriculum that was based on gaining knowledge of drugs first during the 4 pre-clinical years, and applying this knowledge in practice later during the subsequent 2 years of clinical clerkships.

The following aspects contributed to the *validity* of the tests. All case-descriptions in the skills test (SOQ) were based on different core diseases and real patients. The format of the cases was similar as that used in the intervention. The case-descriptions and questions were formulated according to a standardised procedure.[14]

The following aspects contributed to the *reliability*. The knowledge test contained only questions that met the faculty criteria for reliability. With regard to the SOQs, for each case an answer key was formulated and carefully reviewed by four experts. Unfortunately, the reliability of the scores for the SOQ is unknown, since it was not possible to determine whether there were differences between the experts (inter-rater agreement) or differences in two separate scores by the same expert (intra-rater agreement). The four experts were volunteers, and therefore no time-consuming second assessment was performed. Furthermore, the reliability is impaired by the length of both tests.

With regard to the *feasibility*, there were restrictions in both the number of participating students and the length of the two tests. The number of participating students was low because in each of the two faculties the training programme was supervised by one clinical pharmacologist, and therefore limited to two small groups with a maximum of 12 students. The length of the tests was restricted to a maximum of two hours since the students took the tests immediately after their normal training programme.

Remarkable findings

The results indicate that just acquiring knowledge, in itself, does not guarantee that it can be used/applied. The level of knowledge in the control group and the study group was the same, but the students in the control group were less able to apply their knowledge. Thus, applying knowledge obviously requires training and/or experience. Secondly, the results strongly indicate that simultaneously gaining and applying knowledge of drugs and acquiring pharmacotherapy skills

seems to be more effective than the sequential approach of gaining knowledge first, and then learning how to apply the knowledge. This is also supported by the results of the 5th year students who received a sequential training. Instead of learning the cognitive skills in applying the knowledge they are supposed to have, they seemed to use the (obligatory!) skills training for revising 'rusty' knowledge. In our previous study, in which the level of cognitive skills of medical students nearing graduation was assessed, we also found disappointing results for sequential learning with respect to pharmacotherapy.[15] The 6th year students who participated in this study had also followed a sequential type of curriculum, including the obligatory 5th year skills training. Their level of cognitive skills on graduation was 55.8%, which is only slightly higher than those of the 5th and 3rd year students in the present study immediately after their training (44.5% and 46.0%, respectively).

The level of cognitive pharmacotherapy skills in the pre-test (T0) in both the study group and the control group was approximately 27% of the required level for graduation. This indicates that without specific training in these skills the students have learned implicitly during various teaching or clinical experiences, such as patient demonstrations organised for diagnostic problem-solving. It is likely that information about the previous treatment of these patients is also presented and probably discussed.

The significant increase in the level of cognitive pharmacotherapy skills between the pre-test and post-tests in the control group can be attributed to a well-known phenomenon called testing-effect. The students in the control group had learned from the pre-test, and therefore performed better in the post-test. [16] Because the study was performed in a controlled setting with a pre-test/post-test design, this effect was taken into consideration.

Transfer-effect

The above-mentioned considerations can be put into an even wider perspective when taking one remarkable finding of this study into account. The results are based on an assessment of cognitive skills with regard to the treatment of patient problems resulting from 21 diseases, including the four of the training. There was not only a difference between the study group and the control group with regard to the results with regard to the four diseases included in the training, there was

also a difference in the results with regard to the 17 diseases which were not included in the training. This implies that the students did not only remember the specific information they had learned during the training, but that they were also able to apply the acquired skills in new situations, such as solving new therapeutic problems. This so-called transfer-effect of therapeutic teaching has previously been reported in other studies.[17;18] However, it is doubtful whether a transfer-effect is possible in diagnostic problem-solving. Psychometric analyses of tests showed that the performance of a student in one case is not a good predictor of performance in another case, because of case-specificity.[19;20] From cognitive psychological research it has become clear that knowledge is specific for a domain, e.g. for hypertension or diabetes, and therefore not transferable.[5;21] However, in addition to specific knowledge, doctors and students are using general problem-solving skills more and more when acquiring expertise.[21] General problem-solving skills are mainly strategies to solve problems, like sub-dividing the problem into parts and taking decisions in the right sequence.[22] During the pharmacotherapy training, the students learned general problem-solving skills by following the WHO six-step approach to pharmacotherapy, in which the above-mentioned strategies are used. These strategies enabled the students to search for specific knowledge in reference materials, instead of having to learn the specific knowledge. The practical consequence of this finding is that not all methods of treatment or all the drugs for every disease need to be taught and learned, provided that training in general therapeutic problem-solving skills is adequate. To our knowledge this is the first study to demonstrate this effect for pre-clinical students.

Conclusions and recommendations

Taking the above-mentioned limitations and considerations into account, it can be concluded that pre-clinical students seem to be able to learn pharmacotherapy skills simultaneously with gaining pharmacology and pharmacotherapy knowledge. A short training intervention on a voluntary basis already leads to a significant increase in the level of these skills, which lasts for at least nine months. Therefore, it is to be expected that implementation of an obligatory longitudinal training programme throughout the whole pre-clinical phase may lead to higher levels of cognitive skills. It is recommended that explicit practical training in

clinical therapeutics is continued during the clinical clerkships, including feedback on, and assessment of the performance of the students.

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Chapter 5

Evaluation of a longitudinal context-learning programme for pharmacotherapy skills for pre-clinical medical students; a descriptive study

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Abstract

Aim: To evaluate an obligatory longitudinal context-learning programme for approximately 750 2nd–4th year pre-clinical students with respect to mastering cognitive pharmacotherapy skills, therapeutic ready-knowledge, study-load and appreciation.

Programme: The programme consists of a weekly recapitulation lecture, a ready-knowledge test of the 'true minus false' type and role-play sessions for a mix of 108 2nd-4th year students. The role-play sessions are in the form of a consulting hour with three 10-minute therapeutic consultations. Students alternately play the role of doctor, patient and peer-assessor. After having attended 15 role-play sessions (45 consultations), 4th year students sit for a therapeutic Objective Structured Clinical Examination (OSCE) in the outpatient clinic (OPC).

Evaluation: A random selection was made of 192 2nd-4th year students, who had performed as a doctor during the role-play sessions, and of 49 4th year students who had attended the OSCE. The various treatments and information given to the patients were collected and assessed by clinical experts and examiners. The scores of the ready-knowledge tests and a questionnaire were also collected.

Results: During the role-play sessions the 2nd–4th year students mastered the cognitive skill 'choosing (drug) treatments' at 43.3%, 45.0% and 51.0% of the required level for graduation, respectively. For the OSCE the level was 63.9%. A reference group medical students nearing graduation, who had not participated in the obligatory programme, scored 72.6%. For the cognitive skill 'determining the patient information' these levels were 47.3%, 47.2% and 45.3% (role-play) and 69% (OSCE). The score in the reference group was 54.8%. For the ready-knowledge test the students scored 30.1%, 41.8% and 44.8% of the maximum possible score, respectively. The time spent on the role-play sessions and self-study was approximately 1% of the total annual study-load. The students' appreciation of the role-play sessions approximately 80% of the maximum possible score, and for the therapeutic OSCE at the OPC it was 99%.

Conclusions: 4th year students reached levels of competence in the pharmacotherapy skills which were close to those of a reference group of medical students nearing graduation. The effects were achieved with a minimum of study-load, and a maximum of appreciation by the students for the context-learning methodology, the setting of which was as close as possible to actual practice.

Vollebregt JA, Oldenrijk van J, Kox D, Galen van BSR, Sturm B, Hugtenburg JG, Richir MC, Metz JCM, Haan de M, Vries de TPGM. Evaluation of the longitudinal context-learning programme for pharmacotherapy skills for pre-clinical students; a descriptive study. Submitted.

Introduction

Between 1995 and 1998, an educational research project was conducted in four phases at the VU University medical centre Amsterdam (VUmc), the Netherlands. The overall aim was to evaluate the competence in pharmacotherapy of final year medical students, and to increase it if necessary. First, the final year learning objectives for pharmacotherapy knowledge, skills and attitudes were determined in a national survey. [1] Subsequently, also in a national survey, it was found that final year medical students did not meet the requirements of these objectives. [2] This was followed by a controlled trial indicating that pre-clinical undergraduate (3rd year) medical students were well able to learn how to choose and prescribe drugs, simultaneously with gaining knowledge of pharmacology.[3] Based on those results an obligatory context-learning programme for therapeutic skills was developed and gradually implemented in the curriculum of the VUmc for all 750 pre-clinical 2nd-4th year medical students.

The present paper describes a longitudinal pre-clinical context-learning programme for therapeutic skills and the evaluation of the programme. The aim was to evaluate the effect of such a programme on the level of competence of 2nd–4th year pre-clinical students with respect to mastering cognitive pharmacotherapy skills, i.e. choosing a (drug)treatment and determining patient information (including determining monitoring measurements). The level of therapeutic ready-knowledge, the study-load and the appreciation of the programme by the students were also assessed as well as the appreciation of the OSCE by the examiners.

Context-learning

Context-learning is defined as learning in the context of clinical practice. This method of learning is mainly based on studies and theories explaining how medical expertise is achieved, in particular with regard to diagnostic problem-solving. [4] By frequently solving diagnostic clinical problems, doctors gradually generate so-called networks of organised knowledge in their memory. More exposure to patients and thus increasing experience, leads to condensation of these networks into easy accessible diagnostic (illness) scripts. These scripts contain clinically relevant information about diseases, their consequences, the

context in which illnesses develop and the personal circumstances, and experiences of the doctor with patients. Based on recognition, the experienced doctors are then able to choose the right script for solving a specific diagnostic problem efficiently, particularly in routine cases. [5] Less is known about this expertise with regard to therapeutic problem-solving, i.e. choosing *and prescribing* a (drug) treatment. When having to decide on a treatment for a patient with a frequently recurring disease, experienced doctors confine themselves to the information that is already stored in their memory. [6;7] In such cases, doctors make a choice between two to five drug and non-drug treatments related to the disease or symptom(s), as a part of their personal 'standard treatment guideline'. The actual choice is usually heuristic or according to "rule of thumb".

Context-learning is based on these theories, and has four basic principles [8]. The first is that students are learning in a *setting* which is the same as, or similar to the setting of their future profession. For medical students this will be the clinical (and/or research) setting. In this way, students will gain experience in the same way as doctors, allowing them to generate networks of organised knowledge in their memory [9]. The second principle is that within the relevant (clinical) setting students should be given the opportunity to repeat the process of problem-solving in different patient cases. This method of *repetition* allows the students to add new knowledge and experiences to the knowledge networks that will then gradually condense into easily accessible illness scripts. The third principle is that students should receive *feedback* about their performance, preferably immediately afterwards. With regard to clinical problem-solving this will contribute to the right way of generating organised knowledge and the right condensation into illness scripts. Finally, the students should be *responsible* for their own learning as much as possible. This means that students have the responsibility to 'repair' any lack of knowledge or skills that became apparent during the clinical work or the feedback.

There are many variations in context-learning. For the medical curriculum, the most extreme form would consist of (daily) clinical work, in combination with gaining medical knowledge and training of skills, starting at the beginning of the medical curriculum (learning by doing). Other variations could be differences in

the concreteness of the setting of the future profession. These may vary from actual clinical practice with real patients, through practicing with standardised patients, solving written patient problems, and observing patient demonstrations or reading case descriptions in a clinical textbook.

Programme

Since September 1998, an obligatory context-learning programme for pharmacotherapy skills has been gradually implemented in the 2nd-4th study year at the VUmc for approximately 750 medical students. The programme consists of weekly role-play sessions for a maximum of 108 2nd–4th year students. The competence of nine 4th year students was assessed weekly by means of a therapeutic Objective Structured Clinical Examination (OSCE). The students could enrol for both the role-play sessions and the OSCE via a website on the Internet.

Before each role-play session the essential information about symptoms, pathophysiology, pharmacology and treatment options of one core disease is discussed in a *recapitulation lecture*. The disease is one of the three that have been selected for the role-play session. The lecture is followed by an experimental *ready-knowledge test*, in which students can assess their level of therapeutic ready-knowledge about the three core diseases in the role-play. Ready knowledge is considered to be essential for treating patients correctly and efficiently during consultations. In one minute, 10 statements are made about the diseases (symptoms, pathophysiology, prognosis), the treatment (non-drug treatment, drug treatment, side effects, contra-indications), the basic principles of pharmacology and practical aspects of pharmacotherapy For each statement, the students have 6 seconds to indicate whether the statement is true or false, or that they don't know. After the answer sheets have been collected, the right answers are presented and the students can calculate their own score on a copy of the answer sheet: each correct answer is +1, each wrong answer is -1, 'don't know' answers are scored 0. This method of scoring has been chosen in order to prevent lucky-guess behaviour, because this could be detrimental for the patient.

For the *role-play sessions*, 54 written case-descriptions were developed: three cases with a different level of complexity for each of 18 core diseases. These

diseases had been selected from the 68 core diseases that had been determined as final year learning objectives in collaboration with clinicians from the relevant clinical departments. [1]
All case-descriptions were of standard design, with general patient information (e.g. age, gender, occupation and pregnancy), a summary of previous and current diseases and treatments (co-morbidity and medication), and an extensive description of recent history, physical examination, results of physical and laboratory tests and the diagnosis. For all cases the setting was general practice. The levels of complexity were: (A) first consultation of a middle-aged patient with no complicating clinical features, (B) second consultation with (in)sufficient effect and/or occurrence of (no) side-effects, (C) first or second consultation of a patient with co-morbidity and/or medication, or other complicating clinical features.

The role-play sessions are in the form of a consultation hour with three 15-minutes therapeutic consultations. In a therapeutic consultation, all patient information is given, including the (differential) diagnosis. In order to prepare themselves properly, the students are informed well in advance about the three core diseases, but not about the cases, that have been selected for each weekly role-play session.
The basic unit of the role-play sessions consists of three consultations rooms, three patient cases which differ with regard to the disease and the level of complexity (A,B,C), and nine students. Three students play the role of the doctor, three play the role of the patient, and three are assigned as peer-assessors. In each consultation room, the three case-descriptions are laid out in the desk in a certain order.
Before the start of the consultations, each of the three 'doctors' is installed in one of the three consultation rooms. Outside each consultation room, one 'patient' is paired with one peer-assessor. Each patient/peer-assessor couple receives one of the three case-descriptions, including instructions for playing the role and a pre-coded sheet for assessing the performance of the 'doctors'. The couples are placed in front of a consultation room in such a way that the order of the case-descriptions on the desks of the 'doctors' match with that of the 'patients' and 'peer-assessors'.

After 5 minutes of preparation, the couples enter the consultation rooms, and the 'doctors' have 10 minutes to perform the task(s). The ‘doctor’ has to choose the (drug) treatment, together with the ‘patient’, write it down on a treatment/ prescription form, and give the necessary patient information. The ‘doctors’ are allowed to use any source of information or communication they wish. The peer-assessors observe the consultation and score several aspects of the choice of treatment and the patient information on the structured assessment form on a 4-point scale (0=insufficient, 1=moderate, 2=sufficient, 3=excellent). The couples then leave the consultation room, move to the next one and wait in front of it (couple no.1 to room 2, no.2 to room 3, and no.3 to room 1). The 'doctors' then have 5 minutes of preparation for the next patient and the couples can complete the assessment of the performance of the 'doctor' they have just visited. After 5 minutes, the couples enter their next consultation room. This procedure is repeated until the 'doctors' have treated the three 'patients', and the 'patient-assessor' couples have visited all three 'doctors'.
Immediately after the three consultations, the ‘patients’ and peer-assessors will visit the 'doctors' in the same sequence again. In 3x5 minutes, they will ask the three 'doctors' to explain their reasons for the choice of (drug) treatment and record them it on the assessment form. Subsequently all nine students sit together and discuss the various choices of (drug) treatment and the performances. A clinician and a clinical pharmacologist are present as facilitators. Then, the ‘doctors’ collect the case-descriptions, the prescriptions and the assessment forms for their portfolio. Finally, all the students fill in an anonymous questionnaire containing questions about their current study year, the time spent on preparation at home for the present role-play session, their role (doctor, patient, assessor), and their appreciation of the context-learning programme including possible alternatives (see Table 1-III/IV, left hand column).

After having attended 15 role-play sessions (45 consultations) during the 2nd–4th year, the 4th year students take a *therapeutic OSCE*. This OSCE is similar to the RPs, and consists of three basic units for assessing nine students each week. The main differences are that the students have to treat three standardised patients in the outpatient clinic (OPC), and are assessed by trained examiners. The students are not informed in advance about the three core diseases or about the

cases. The standardised patients were trained to play their role as uniformly as possible, and each time they played the role they were given written instructions in advance. On a continuous basis, each OSCE is evaluated in a structured way immediately afterwards with the students and examiners. A CD-ROM that can be found in the back cover of this thesis gives an impression of the OSCE.[1]

The undergraduate medical curriculum at the VUmc consists of a pre-clinical phase of four years, followed by clinical clerkships for two years. The pre-clinical phase is mainly based on thematic blocks regarding certain organ systems. In each block students learn about anatomy, physiology, pathophysiology and clinical features, including pharmacology and the drugs used for the diseases of that system. Simultaneously, approximately 10% of the total study-load, consists of students learning in small groups to apply the previously gained knowledge to solve patient problems. The context-learning programme for pharmacotherapy skills is embedded in the problem-solving education

Evaluation

Population

One year after the full implementation of the programme (2001-2002) a random selection was made of 192 2nd-4th year students who had enrolled as a 'doctor' during the RPs. Among them were 61 2nd year, 74 3rd year and 57 4th year students. 49 4th year students who took the OSCE were also randomly selected. This was, on average, 25% of the year classes. Non of the 'doctors', peer-assessors (role-play) or examiners (OSCE) were informed in advance that the evaluation would take place. At the end of the study year, the participating students were compared to the rest of the students in their year classes. There were no differences in peer-assessment or OSCE examiner assessment between the selected students and the other students.

Test

For the evaluation, six core diseases with each three case-descriptions at a different level of complexity (A, B, C) were selected. For each of the three study years, two diseases were selected that had been discussed already in the

[1] Some copies of the thesis do not contain a CD-ROM because of financial restrictions

thematic blocks: non-insulin-dependent diabetes mellitus (type II); iron-deficiency anaemia; migraine; depression; acute otitis media and osteoarthritis deformans. All students selected for the evaluation received a selection of these 18 case-descriptions during the role-play/OSCE in such a way that the three cases concerned a differed disease and level of complexity (A, B, C).

Scoring and analysis

During the three consultations the clinical performances of the selected students were audio-taped, in addition to the regular observation and assessment by peer-assessors and examiners. For each case all the different types of treatment recorded on the treatment/prescription forms and all the audio-taped information given to the patients was summarised on scoring sheets. The scorer therefore could not read the name of the student, the study year or whether the score concerned a role-play session or an OSCE. These sheets were presented to six independent voluntary experts, one for each disease. For each case an answer key was formulated and carefully reviewed by the examiners. They scored the different types of treatment and patient information on a 4-point scale (0=insufficient, 1=moderate, 2=sufficient, 3=excellent). Each student was then given a score for the choice of treatment and the patient information. Additionally, the scores for the ready-knowledge tests and the questionnaires were collected from all students participating in the role-play sessions. The questionnaire from the students and the examiners in the OSCE were also collected.

All scores were entered in a database (SPSS 9.0) and descriptive statistics were calculated in percentages of the required level for graduation with regard to the cognitive skills, and as a percentage of the maximum possible score for knowledge and the questionnaire. All differences were analysed by applying the Student's *t*-test. $P<0.05$ was considered to be statistically significant.

Results

Cognitive pharmacotherapy skills

According to the experts, the 2nd, 3rd and 4th year students mastered the cognitive skill *'choosing a (drug) treatment'* at a level of 43.3%, 45.0% and 51.0% of the required level for graduation, respectively, during the role-play sessions (Table 1-

Ia). The scores of the 4th year students were significantly higher those that of the 3rd and 2nd year students. This is mainly due to their higher scores for the A-cases. The scores of the 3rd year students for the B-cases were significantly higher than those of the 2nd year students. There was no difference in scores between the 2nd, 3rd and 4th year students for the C-cases. However, 3rd and 4th year students were significantly less competent in this skill in the most complex cases (C) than in the less complex cases (A,B). In the OSCE the score was 50.2% according to the experts, but the examiners, who had observed the students during the OSCE, scored significantly higher: 63.9%. This is mainly due to a significantly higher score for the C-cases given by the examiners in the OSCE. The level of the 4th year students in the OSCE was significantly lower than the level of 6th year students nearing graduation (72.6%) that had been determined in a previous study, also in an OSCE setting. [2] These 6th year students had not participated in the context-learning programme in therapeutics.

The experts indicated that the 2nd, 3rd and 4th year students mastered the cognitive skill *'determining the patient information'* at 47.3%, 47.2% and 45.3% of the required level for graduation, respectively (Table 1-Ib). There were no differences between the scores of the 2nd, 3rd and 4th year students for this skill. For the patient cases with different levels of complexity (A, B, C) there were also no differences between the scores of the 2nd, 3rd and 4th year students. In the OSCE this level was 50.7% according to the experts. The examiners, who had observed the students, scored substantially higher: 69.0%. This is mainly due to a significant difference in the scores for the B-cases. The level of the 4th year students in the OSCE was significantly higher than the level of 6th year graduates: the summation of determining patient information (43.6%) and determining monitoring measurements (66.0%). [2] For both therapeutic skills the peer-assessment scores during the role-play sessions were all significantly higher than the scores given by the experts (Table 1; Ia+b).

Ready-knowledge of therapeutics

The true-minus-false scores for the experimental ready-knowledge test in therapeutics of the 2nd, 3rd and 4th year students were 30.1%, 41.8% and 44.8% of the maximum score, respectively (Table 1-II). The 3rd year students scored significantly higher than the 2nd year students, but there was no difference

between the scores of the 3rd and 4th year students. There were hardly any differences between the scores of the students who prepared for the role of doctor, patient or peer-assessor. Furthermore, there were no differences between the scores regarding the questions about the diseases, treatments and basic pharmacology/ pharmacotherapy aspects.

Study-load

Students who played the role of doctor spent an average of 1½ to 1¾ hours on study at home in preparation for each role-play session (Table 1-III). Students who played the role of patient and peer-assessor spent less time on preparation. Together with the time spent on attending the role-play sessions (2.5 hours) the 2nd, 3rd and 4th year students spent 22, 22 and 11.5 + 22 (OSCE) hours, respectively, a year for this purpose, which represents approximately 1% of the total study-load.

Appreciation

The students' appreciation of the role-play sessions (RPs) was between 78% and 82% of the maximum (Table 1-IV). The scores for possible alternatives for the RP showed that the students appreciated training in real practice slightly more: 77-82% for general practice, 78-86% for the outpatient clinic (OPC). They appreciated problem-solving sessions in small groups and computer-assisted instruction less: 58-70% and 48-66%, respectively. The therapeutic OSCE at the OPC was valued at 99% of the maximum by the students. Some personal remarks made by students about the role-play sessions/OSCE were: 'preparing for the RP, I used guidelines and I read these guidelines with the purpose of applying the knowledge in the RP'; I have learned that handling uncertainties is very important in the medical profession'; 'RP should be used more in the other problem-oriented aspects of education'; 'no change please, but an OSCE each year'; 'RP not in the evening but during the day, because it is a serious subject'; 'first RP, followed by recapitulation lecture and then argumentation'; 'despite a lot of stress, it was very nice to take the OSCE'; 'the setting of the OPC made you feel like a real doctor'; 'this OSCE is the first time in the study that you get personal feedback about your performance from a real medical doctor'; 'I would take the OSCE again if I could, even if there was a chance that I might fail'.

Table 1. Results: the assessment of the cognitive skills (I) and knowledge test (II) as a percentage of the maximum (95% CI), study-load in hours per year (III), and the questionnaire (IV) as a percentage of the maximum.

		Role-play sessions			***OSCE***	***Reference****
		2nd year (n=61)	*3rd year (n=74)*	*4th year (n=57)*	*4th year (n=49)*	*6th year (n=66)*
I. Therapeutic skills						
a. choosing a (drug) treatment						
All cases:	Peer-ass. / **Examiner**	66.5 (62.7-70.1)	75.1 (70.9-79.2)	74.4 (70.5-78.2)	**63.9 (58.1-69.8)**	72.6 (71.4-73.8)**@**
	Experts	43.3 (38.5-48.1)	45.0 (40.9-49.1)	51.0 (45.2-55.2)**#**	50.2 (45.2-55.1)**+**	
Level A:	Peer-ass. / **Examiner**	72.9 (66.7-79.1)	78.8 (71.8-85.9)	82.8 (75.9-89.7)	**60.4 (51.5-69.3)**	
	Experts	45.2 (37.4-53.0)	45.4 (38.1-52.7)	56.5 (50.0-63.1)**#**	55.6 (45.0-66.1)	
Level B:	Peer-ass. / **Examiner**	68.0 (57.1-78.9)	75.2 (67.9-82.4)	70.8 (66.0-75.6)	**59.2 (49.0-69.4)**	
	Experts	46.4 (33.9-58.9)	51.7 (44.6-58.9)**#**	52.8 (43.4-62.3)	55.3 (49.7-60.9)	
Level C:	Peer-ass. / **Examiner**	63.0 (58.3-67.7)	71.6 (66.0-77.3)	64.7 (57.9-71.3)	**69.8 (61.3-78.4)**	
	Experts	45.0 (38.8-51.1)	41.6 (36.8-51.1)**†**	44.4 (38.3-50.6) **†**	39.0 (30.1-47.7)**+**	
b. determining patient information						
All cases:	Peer-ass. / **Examiner**	75.1 (70.7-79.4)	75.6 (71.1-80.1)	72.5 (68.5-76.6)	**69.0 (62.2-72.2)**	54.8 (53.3-56.1)**@**
	Experts	47.3 (44.5-50.1)	47.2 (43.8-50.6)	45.3 (41.6-49.0)	50.7 (47.3-54.3)**+**	
Level A:	Peer-ass. / **Examiner**	79.0 (72.4-85.6)	75.7 (64.2-87.2)	75.8 (69.4-82.3)	**62.1 (52.0-72.2)**	
	Experts	46.6 (42.6-50.7)	52.4 (47.9-56.8)	45.0 (37.2-52.8)	49.2 (42.0-56.6)	
Level B:	Peer-ass. / **Examiner**	73.3 (63.9-82.8)	79.3 (63.9-82.8)	74.6 (66.9-82.2)	**74.6 (65.1-84.6)**	
	Experts	44.4 (38.6-50.3)	45.9 (42.6-49.4)	40.8 (34.0-47.7)	49.2 (39.9-52.5)**+**	
Level C:	Peer-ass. / **Examiner**	71.2 (64.7-77.7)	73.2 (67.7-78.7)	59.8 (53.5-66.0)	**63.2 (53.3-73.0)**	
	Experts	54.7 (49.8-59.6)	51.2 (45.5-56.9)	50.0 (45.4-54.7)	54.5 (47.7-61.3)	

II. Ready-knowledge (% of max.)	*2nd year (n=61)*	*3rd year (n=74)*	*4th year (n=57)*	*4th year (n=49)*
Students with doctor-role	36.4 (29.6-43.2)	44.7 (39.6-49.8)	44.0 (35.3-52.8)	
Students with patient-role	27.6 (21.9-33.2)	38.0 (31.6-44.4)	41.8 (33.1-50.6)	
Students as peer-assessor	25.6 (18.8-32.5)	42.3 (37.6-46.9)**#**	48.5 (39.3-57.7)	
Average score	**30.1 (26.4-33.9)**	**41.8 (38.7-44.9)#**	**44.8 (39.6-49.9)**	
III. Study load (hours)				
Preparation for doctor-role	3½	3	1¾	22
Preparation for patient-role	1½	1½	1	
Preparation for peer-assessor	2	2½	1¼	
Role-play attendance 6 sessions	15	15	7½	
Total hours per year	22	22	11.5	
IV. Appreciation (% of max.)				
Current programme: role-play	78	82	78	
OSCE				99
Alternatives :real practice GP	82	77	80	
real practice OPC	78	86	83	
small group teaching	58	67	70	
computer education	61	66	48	

#: difference between the scores of 4th and 3rd year students, or 3rd and 2nd year students
†: difference between the scores for level C cases and those for level A and B cases
+: difference between clinical experts and clinical examiners
@: significant difference with OSCE (4th year)
* [2]
GP: general practice
OPC: outpatient clinic
OSCE: objective structured clinical examination

Some comments made by the examiners were: 'each successive year, the level of performance of the students had improved'; 'the examination is time-consuming and the doctors from the department have to come for a whole year, but it is very nice to be involved'; '5 minutes is not long enough for the 'doctor' to give his or her reasons for the choice of (drug) treatment, and as an examiner you want to teach the student something'.

Discussion

The aim of the study was to evaluate an obligatory context-learning programme for pharmacotherapy skills. It was organised as part of the existing pre-clinical curriculum that mainly consists of thematic blocks and patient-oriented problem-solving in small groups. The primary aim of the study was to evaluate the effect of context-learning on the level of mastering cognitive pharmacotherapy skills in 2nd, 3rd and 4th year pre-clinical medical students. A secondary aim was to evaluate the programme with regard to the level of ready-knowledge, the study-load, and the appreciation of the students as well as the teachers.

The five main findings of this study are that:

1. there was a relatively small increase in the level of mastering cognitive pharmacotherapy skills for 18 core diseases by 2nd-4th year medical students, with a significant increase in the 4th year students;
2. the level of ready-knowledge of pharmacology and pharmacotherapy increased significantly, in particular in the 3rd year;
3. the pre-clinical students reached both levels after only 15 role-play sessions (five times playing the role of 'doctor') with a relative low study load;
4. the students highly appreciated context-learning, in particular the OSCE at the OPC, as did the examiners, although for them it was time consuming;
5. the level of the 4th year students was close to that of 6th year graduates who had finished their clinical clerkships but had not followed the pre-clinical context-learning programme.[2]

Generalisation, validity, reliability and feasibility

The students were randomly selected from the three year-classes and from the students who participated in the OSCE. The selected students did not differ from

the rest of the students in their year-class with respect to the peer-assessment and the OSCE assessment. Therefore, the results can be generalised to all VUmc students in the 2nd–4th year of the, but to a lesser extent to students in other medical faculties because of differences in the curricula of the various medical faculties in the Netherlands.

The following aspects contributed to the *validity*. The role-play sessions and the therapeutic OSCE took place in a similar setting, and the same structured assessment form was used. Furthermore, the case-descriptions were based on real patients in a general practice setting, and were all standard in design. Therefore, the content validity was high.

With regard to the OSCE, the following aspects contributed to *reliability*. In general, the standardised patients were instructed by role-training and instructions. However, it is not clear to what extent they consistently played the same role. For each case an answer key was formulated and carefully reviewed by the examiners. All examiners were instructed on how to use the structured scoring list and each week nine examiners participated in the OSCE. It was not possible for the clinical departments to send more examiners in order to determine whether there were differences between examiners. Unfortunately the reliability of the scores for the OSCE remains unknown. For similar reasons, it was not possible to test the inter-rater reliability with respect to the expert scoring of both the role-play sessions and the OSCE.

The absolute figures for the levels of mastering the cognitive pharmacotherapy skills in the OSCE should be interpreted with some care, in particular the differences between the (higher) scores given by the examiners and the (lower) ones given by the experts. Differences in the method of assessment seem to play an important role. In contrast to the experts, the examiners knew that they were assessing 4th year students, observed the students, and thus knew the content of the conversation and discussion with the patient. They also discussed the treatment choice with the student during the 5 minutes immediately following the consultation. The reasons given by the students for their choice rightfully influenced the score given by the examiners, whereas the experts did not know the students' reasons. In particular, this might have contributed to the differences in the choice of treatment in the C-level cases and the patient

information in the B-level cases. These cases were complex, and the standard treatment or communication was not always applicable. It can be argued that reasons given by the students in these cases might influence the examiners to a greater extent than in the A-level cases. On the other hand, because of this difference in assessment, it can be argued that the experts scored more objectively, whereas the examiners may have been influenced by the circumstances. For example, the assessment of a stressed student struggling to survive may be different if it is preceded by a consultation in which the student's performance was very professional. However, each student was assessed by three different examiners and in most cases the scores and opinions of the examiners did not differ very much.

With regard to the *feasibility* of the role-play sessions, 15 sessions was the maximum for both logistic and time-consuming reasons, since there was very little time left in the fully occupied curriculum. Financial reasons and lack of time for the examiners restricted the OSCE to three stations.

Other findings of the programme

The scores for the experimental ready-knowledge test may seem low. However, an average true-minus(!)-false score of 44.8% may be considered relatively high because the correction for guessing is normally made later for the entire test without the deduction of false answers. Furthermore, it is a rather stressful type of examination to which the students were not yet fully accustomed to it. In fact, at first they objected strongly because they had too little time to reflect on each short statement (6 seconds), and because they were 'punished' for guessing. After the importance of having correct ready knowledge in daily practice was repeatedly explained and the students experienced the need or ready-knowledge in the role-play sessions, their resistance decreased.

Because the context-learning programme is only a small element in the whole curriculum, the measured impact cannot be ascribed to this programme solely. However, training in therapeutic problem-solving is scarce in education in the 2nd-4th study years. The emphasis of the problem-oriented education is mainly on diagnostic problem-solving. The higher levels of competence in the skills in comparison with earlier measurements in the control-group of pre-clinical 4th year students, indicate that the measured impact is due to the new programme.[3] It

has been reported in pre-clinical students the transfer of general problem-solving skills in pharmacotherapy might be a contributing factor. General problem-solving skills are mainly strategies such as subdividing the problem in parts and taking decisions in the right sequence. Using these strategies, the students were able to search for specific knowledge in reference materials.[3]Therefore it can be expected that they are able to employ the skills in all 68 core diseases determined in the final year learning objectives, even though they only learned the pharmacotherapy skills for 18 core diseases in the context-learning programme.

Learning conditions

In addition to the above described methodological aspects, in the interpretation the results of this study one should take into account the learning conditions of the context-learning programme. These conditions are, in particular, determined by its four basic principles: the setting, the number of repetitions, the feedback and the personal responsibility for learning.

The *setting*, i.e. role-play sessions can be placed in about the middle of the spectrum of concrete settings of the future profession. This spectrum runs from real practice with real patients (under supervision), via simulated practice situations with standardised patients and role-play, to less concrete situations such as solving written patient problems in small study groups, patient demonstrations during lectures, and reading case descriptions in textbooks. [8] Role-play was the maximum possible achievement, because it is difficult to obtain real practice settings and (standardised) patients for large numbers of students. It can be argued, however, that role-play sessions in which students play the roles of doctor, patient and peer-assessor have certain advantages. For instance, students indicated that both the role of patient and the assessor gave them the opportunity to observe and discuss the performance of three doctors for the same case and consultation. Although all the students favoured the role of doctor, and said that it was very instructive, they were of the opinion that they also learned a lot from the other roles.

It is not known what the ideal *number of repetitions* is in order to add knowledge and experience to the knowledge networks and to condense these into easily accessible illness scripts. For about 750 students from three year-classes, 15 role-

play sessions and a therapeutic OSCE for each student was the maximum possible for reasons of logistic (consultation rooms), personnel and teaching time. The results of this study are based on the fact that the student only played the role of the doctor five times, and observed either as a patient or as an assessor the performance of their peer-students 10 times. This means that each student solved only 15 patient cases and observed another 30 cases, and spent about 22 hours per year on the programme. Nevertheless, the examiners were of the opinion that the level of the cognitive pharmacotherapy skills was sufficient for students to commence their clinical clerkships.

The third principle concerns *the quality of feedback* the students received on their performance. Ideally, feedback is given immediately after performance, by teachers who are trained in giving feedback.[10] The feedback in this programme was performed by peers after the role-play sessions. The results show that the assessment by peers did not meet the expectations. For all three study years, and for all levels of cases, the peer assessors scored much higher than the experts, and even higher than the OSCE examiners in the 4th year. There are several possible explanations. First, as the results of the study-load indicated, the peer-assessors spent less time on preparation than the students who played the role of the doctor. Secondly, the peer-assessors lacked clinical experience. Thirdly, 2nd year students sometimes assessed 3rd or 4th year students. The fourth reason is that students, when asked about the reason for their high assessment scores, indicated that it was 'not done' to criticise fellow-students who are also friends or at least fellow-students facing the same problems. Finally, the students were not trained to assess the skills during role-play sessions. The above-mentioned reasons explain why the peer-assessors were not able and/or not willing to assess their fellow-students more critically.

The final principle for efficient context-learning is *the students' responsibility for their own learning*. Ideally, the students should have 'repaired' any lack of knowledge and skills that became apparent during the role-play sessions and the feedback. The present study has not examined this effect, though the relatively low study-load indicates that this was not optimal. This is due to the fact that the pharmacotherapy programme had to compete with other elements in the teaching programme. Other obligations, and in particular examinations, often had a higher

priority. The fact that at least part of the other elements of the teaching programme is merely learning factual knowledge, accounts for the students being less responsible for their own learning, but contributes to 'spoon-feeding' behaviour. They had to become accustomed to their own responsibility and to shift from this behaviour ('tell me what I should do/learn, and I will do it, take the exam and get it over with') to self-reflection and self-learning.

Conclusions and recommendations

Taking the above-mentioned limitations and considerations into account, we found a strong indication that pre-clinical context-learning has a positive effect on learning cognitive pharmacotherapy skills, i.e. choosing a drug treatment and determining patient information. This effect has been obtained with a sub-optimal form of context-learning (role-play sessions in the medical faculty and an OSCE in the outpatient clinic), and a minimum of study-load, and is highly appreciated by students and examiners. Recommendations for further education and research are based on the four principles of context-learning. With regard to the context of the programme, it is recommended that the students are able to learn in an environment with the highest level of concreteness.[8] This means that the students gain personal experience in seeing and dealing with real patients in the clinic. In order to create a maximal realistic situation, students should be confronted with the entire consultation so that they can apply both their diagnostic and their therapeutic skills.[11] The effect of such a programme on both the level of knowledge and the clinical skills of future doctors should be studied on a continuous basis.

With regard to the context-learning programme for pharmacotherapy described here, it is recommended that the optimum of number of sessions is to be determined. Therefore, both the level of pharmacotherapeutic skills and knowledge of the students should be measured on a continuous basis including during the two years of clinical clerkships, with at least a therapeutic OSCE in each study-year. The peer-assessment can be improved by taking measures to ensure that the students prepare themselves better, for instance by introducing an obligatory knowledge-test as an entry-test for each session, to give students the opportunity to gain clinical experience, and to train them in peer-assessment.[12] Finally, to improve the students' responsibility for their own

learning, it is recommended to replace the student with the role of patient and the peer-assessor randomly by a standardised patient and an examiner. It is to be expected that after these improvements, and after carefully evaluation of their effects, future doctors will be better prepared for the rational prescriptions of drugs.

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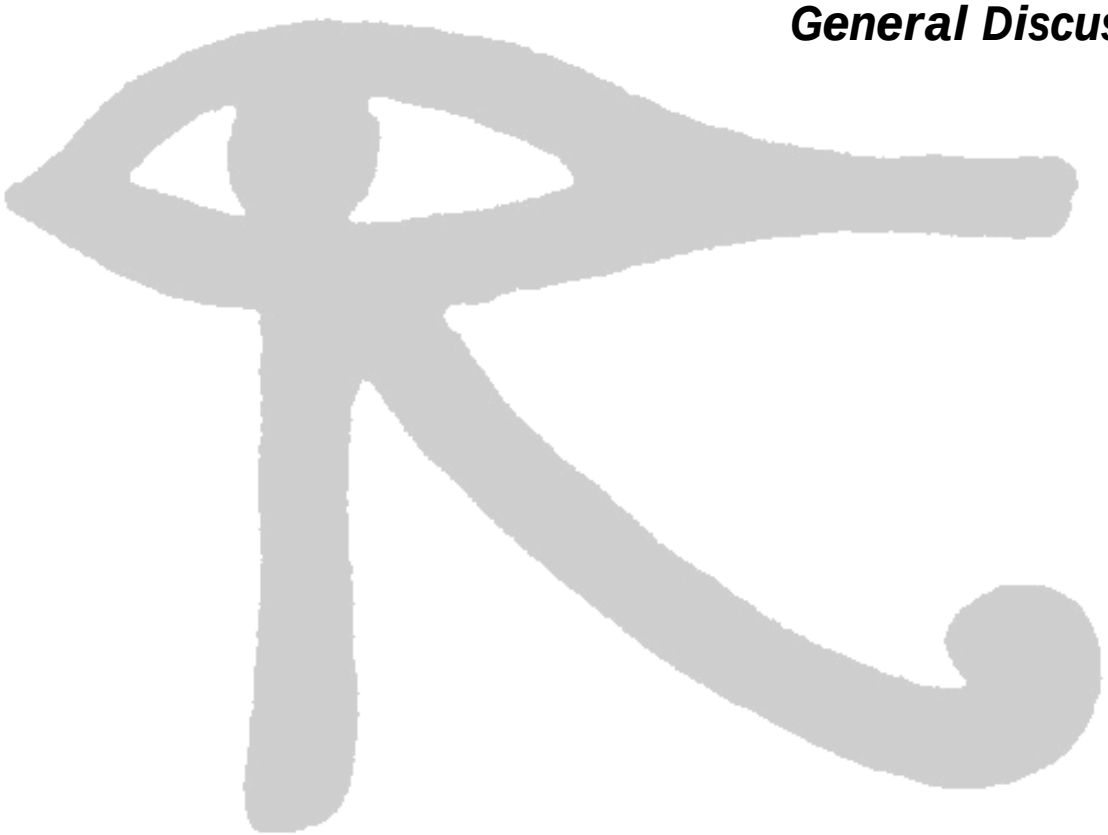
Chapter 6

General Discussion



This thesis describes four phases in the development of an undergraduate curriculum for pharmacotherapy. In the Introduction, the reason for this development has been discussed (Chapter 1). It was generally believed that improvement in the undergraduate pharmacotherapy teaching-programme was called for, and would contribute to better drug-prescription by doctors. Therefore, a project was initiated with the general aim to evaluate the level of competence in pharmacotherapy of medical students nearing graduation, and to seek ways to improve it if necessary. Four studies were performed between 1995 and 2002 in an attempt to achieve these aims. The results of these studies indicated that:

1. The Dutch final year pharmacotherapy objectives, determined in a national survey in 1995, require that final year medical students should be able to treat patients with a core disease, and for that purpose they should be competent in all relevant pharmacotherapy skills at the highest possible level, have sufficient knowledge of pharmacology, and have a critical attitude with regard to irrational drug-prescribing (Chapter 2).
2. In 1996, a randomly selected group, consisting of 5% of the final year medical students in the Netherlands, did not sufficiently comply with the requirements for these objectives, in particular with regard to the necessary cognitive, communication and motor skills (Chapter 3).
3. In 1997, in a controlled research setting, 3rd year medical students from the VUmc and AMC/UvA showed their ability to learn cognitive pharmacotherapy skills simultaneously with gaining pharmacology knowledge when participating in a short problem-solving training programme for pharmacotherapy (Chapter 4).
4. There was an increase in the level of competence in cognitive pharmacotherapy skills and pharmacotherapy knowledge in 2nd-4th year VUmc students who participated in an obligatory context-learning programme for pharmacotherapy between 1998 and 2002 (Chapter 5).

The specific methodological aspects of these studies, in particular with respect to the generalisation of the results, and the validity and reliability of the tests, have been discussed in the various chapters. They will be discussed here more generally within the context of competence and context-learning.

Competence and context-learning

The main two themes of this thesis are the competence of medical students with regard to pharmacotherapy (cognitive) skills, and the context in which these skills are learned and assessed. Both have been presented and discussed in the various chapters. In particular the objective of the controlled study was to determine whether pre-clinical students were able to acquire these skills (Chapter 4), and in the following study a context-learning programme for pharmacotherapy skills was evaluated (Chapter 5). The main findings of these two studies will be discussed in general with respect to current considerations regarding clinical competence and performance and the concept of context-learning.

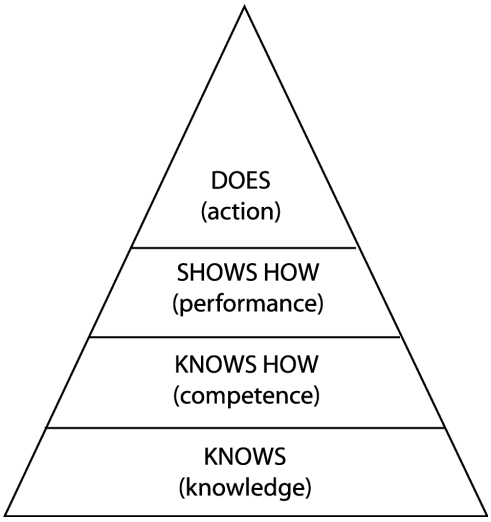


Figure 6.1 *'Pyramid' by Miller as an illustrative framework for discussing the assessment of clinical skills, competence and performance [1]*

Competence

For illustrative purposes, Miller presented a framework in 1990 when discussing various forms of assessment, and in particular the assessment of clinical skills, competence and performance.[1] He presented this framework in the form of a pyramid (Figure 6.1). At the base it indicates that a student, a resident, or a physician should have *knowledge* in order to carry out the required professional functions effectively. The next layer of the pyramid indicates that students must also *know how* to use this knowledge for the required functions. For example the skill that is needed to acquire information from a variety of human and laboratory sources, to analyse and interpret the data, and finally to translate such findings

into a rational diagnostic or management plan. Miller quotes Webster's dictionary (without reference) that defined this 'know-how' quality as *competence*.[1] The subsequent layer indicates that students should be able to demonstrate (in an observed or examination setting) not only that they *know* and *know how*, but that they can also *show how* they do it when faced with a patient. Miller calls this ability *performance*.[1] Finally, in the top layer, he raises the important question of whether what is performed in an artificial learning or examination setting can accurately predict what a graduate actually *does* when functioning independently in clinical practice, the *action* component of professional behaviour.[1] Furthermore, Miller states, on the one hand, that it may be reasonable to assume that either action or performance implies achievement of the more basic elements of the triangle. On the other hand, measurement of knowledge and competence cannot be assumed to predict fully and with confidence the achievement of the more complex goals. He concludes in this respect that faculties should seek both instructional methods and evaluation procedures that fall in the upper reaches of this pyramid, since examinations drive the educational system. Examinations convey in the most clear and realistic terms what students must learn or do in order to succeed.

The reason for, and the overall aim of this thesis are in concordance with the above-mentioned theory. On the basis of the literature presented in the Introduction, it has been concluded that the rationality of drug-prescribing found in postgraduates (and practising doctors) was insufficient. Since these young doctors had graduated after passing clinical examinations (performance), it can also be concluded that the drug-prescribing performance of students in an examination setting did not accurately predict what they actually would do when functioning independently as postgraduates in a clinical practice (action).
Furthermore, there are indications that drug-prescribing skills may not even be addressed in clinical examinations. Therefore, the overall aim of the studies described in this thesis was to seek instructional methods and evaluation procedures relevant to pharmacotherapy training.

[1] In this thesis the definitions of competence and performance are those formulated by Rethans: competence is defined as what a person is capable of doing in an observed/examination setting, and performance is what a person does in daily practice.[17] Miller defines the first (competence) as performance and the second (performance) as action.

Context-learning

In the third study (Chapter 4) it was shown that pre-clinical students are able to learn cognitive pharmacotherapy skills, i.e. choosing and prescribing drugs, simultaneously with gaining knowledge. According to Miller, *competence* in choosing and prescribing drugs was trained. Furthermore, it has been discussed that this outcome was in concordance with the theories concerning context-learning and gaining expertise. There is growing evidence that gaining knowledge along with applying knowledge is more effective than sequential learning.[2] This is explained by the increase in experience of the doctor. Frequently solving (diagnostic) problems and more confrontation with patients in the context under which illnesses develop, enables the doctor to choose the right script for solving a specific (diagnostic) problem efficiently.[3-5] For that reason, the main instructional and evaluation (assessment) method used in the pharmacotherapy programme described in Chapter 5 was a context-learning setting: role-play sessions and an examination (OSCE) at the outpatient clinic. In this way the students gained the pharmacology and pharmacotherapy knowledge simultaneously with solving patient problems, and stored this knowledge together with the clinical problems for which it was used. The assumption is that when the student has to solve such patient problems again, for example in clinical practice or in a clinical examination, the knowledge will be recalled much more accurately and rapidly.[6]

As discussed in Chapter 5, context learning may vary with regard to the concreteness of the setting of the future profession. The most realistic concrete form is actual clinical practice with real patients. Less concrete forms are practising with standardised patients, solving written patient problems, observing patient demonstrations and reading case descriptions in a clinical textbook, the latter being one of the least realistic forms.

Similar to Miller's pyramid concept, the most realistic form of context-learning – learning by doing in actual (clinical) practice- can be illustrated in a reverse pyramid (Figure 6.2). Under supervision, students are placed in an actual practice situation from the start of their studies. At first, the tasks are relatively simple, but with a certain level of responsibilities. Gradually, as the student

gains more experienced, the level of performance and competence will grow, together with the responsibilities, and the knowledge will increase.

For various reasons, this extreme form of context-learning will not be suitable for medical education. Because medical problems are too serious and often require correct and immediate intervention, patients cannot be put into the hands of an unskilled student, even under supervision. Moreover, this method is probably highly inefficient and with such an approach it would take a lot of time for students to achieve the required level of professionalism. Furthermore, the large body of knowledge that is available, can be studied in a relatively short time. Moreover considerable experience has been gained in training clinical competence. Another reason why it is unsuitable, is that first year medical students do not know the scope of the clinical problems they will encounter as physicians. They are therefore less able to determine the extent to which the skills and knowledge they have to learn will be useful.[7] On the other hand, when students are confronted with clinical problems that they have to solve by themselves, they become aware of their own deficiencies, and are better able to tailor the learning to their own needs.[8]

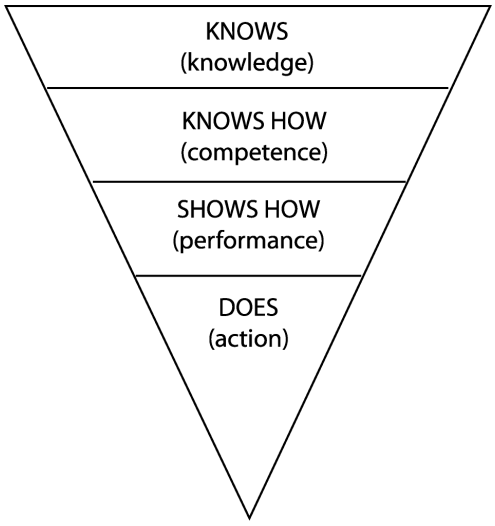


Figure 6.2 *Combination of competence and context-learning*

Miller's pyramid of and its interpretation can also be applied to sequential learning, i.e. learning knowledge first, followed by learning how to apply this knowledge in problem-solving (competence, performance and action). In the extreme form of context-learning this is the other way around: through training in

actual practice (action) the level of performance, competence and knowledge will gradually grow. A combination of both would probably result in an acceptable and efficient curriculum. This can be illustrated by combining both of these pyramids (Figure 6.3).

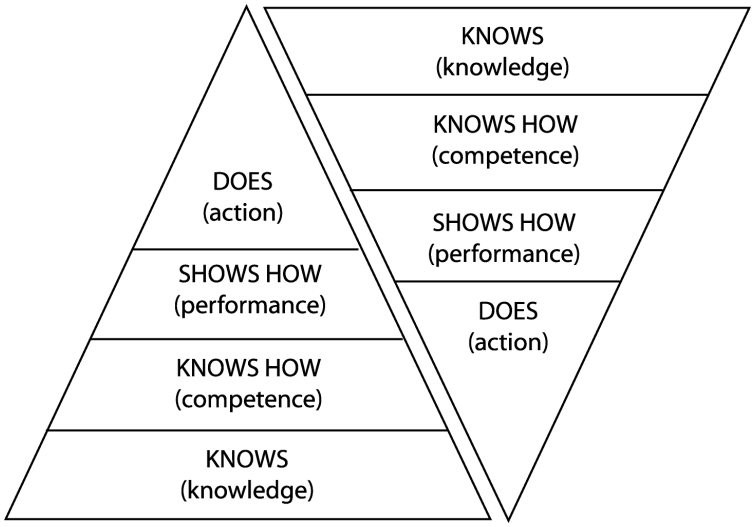


Figure 6.3 *Combination of Miller's pyramid and the reversed one*

For example, from the start of their study medical students could spend half a day in a clinical practice and half a day in a (clinical) research setting each week. The rest of the week consist of lectures, teaching in problem-solving in small groups, laboratory and skills training, self-study, and working out assignments derived from the patients they have seen that week and from the research activities during that week. Each year the students will be given more responsibilities, depending on their performance and examination results.
Another example is the curriculum that is currently being developed at the VU University Medical Centre (Van Rossum H; www.med.vu.nl). Its framework is presented in Figure 6.4. and shows similarity with the two combined pyramids.
In addition to working in actual practice, students are simultaneously studying (knowledge) and practising (skills). Starting from the first year, the work in actual practice gradually increases, but at the end of the curriculum the amount of time allocated to studying and practising is still considerable.

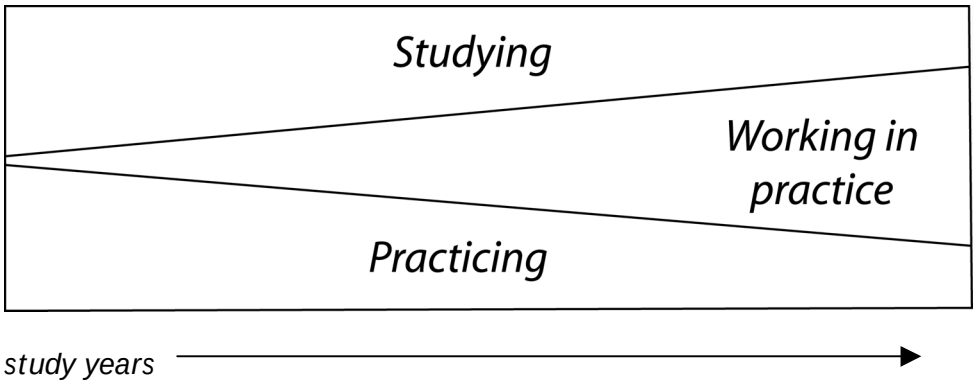


Figure 6.4 *Model of medical curriculum of VU university Medical Center*

In general, learning involves building networks of information and experience. Learning is goal-oriented, which means that the relationships between the various facts (knowledge) and actions (competence/performance/experience) are specified. The way new knowledge will be stored in the memory, and the amount of new knowledge that can be stored, depends on the meaning that can be given to it, i.e. the extent to which it can be linked to networks of prior knowledge and experiences.[9] Therefore, learning new information depends on the extent of activation of prior knowledge, and both new and old knowledge can be restructured in elaborated causal networks.[10] This implies that context-learning should be part of a medical curriculum from the beginning, together with gaining knowledge and the skills to use this knowledge for medical problem-solving.

The evaluation of such a context-learning programme – in fact of any teaching programme - should be aimed at measuring the knowledge, competence and, eventually, the performance of graduates in such a way that it can predict fully and with confidence their future achievements in daily practice. The method of evaluation presented in the last study (Chapter 5), based on a therapeutic examination (OSCE) in the outpatient clinic with standardised patients and clinicians as examiners, is just a first step in that direction. Important issues with regard to the reliability of this measurement still have to be addressed: e.g. inter-rater agreement, inconsistency of standardized patient performance, the required number of stations due to variation in student performance across the stations, and the required number of examiners.

Equally important is the issue of the validity of the measurements. Apart from the relatively rare empirical validation studies (for example, measuring concurrent validity by means of correlation studies) two other issues are of importance in this matter.[1] The first is the widely accepted fact that performance is embedded in knowledge that can be expected to increase, and thus will influence performance as the stage of education advances. The second is that the results of correlation studies are usually derived from the scores of rankings of norm-referenced tests, rather than from the specific behavioural achievements of mastery-referenced appraisals. However, there is still debate about the most effective methods for developing performance standards. According to Miller this issue has been successfully evaded in the past through the application of norm-referenced testing, simply ranking candidates with arbitrary cut-off points. This would reflect distinctions far more than differences. For 'high risk examinations' that qualify candidates for independent general or specialist practice, it seems imperative to adopt a criterion-referenced method. However, combining an increase in both reliability and validity of the tests for measuring performance will be difficult, given the reverse relationship between the two.

General recommendations

Based on the results presented in this thesis, and on the above-mentioned considerations regarding clinical competence/performance, the following general recommendations are made for future medical education and research on medical education.

Medical education

It is recommended that when universities are planning to change their pharmacology/pharmacotherapy curriculum, the learning objectives for pharmacotherapy are first determine in a similar way as that is described in this thesis, and that the level of competence of the graduates is measured. If this level is not satisfactory, sub-levels for these learning objectives should be determined for the relevant years or elements of the undergraduate curriculum.

According to the findings described in this thesis, a teaching and assessment programme should be chosen that is as close to context-learning and assessment

as possible. Detailed information about these subjects, and also about pharmacotherapy teaching, can be found in the Teacher's Guide to Good Prescribing. [11] In addition to providing valuable information about various teaching and assessment methods, it also gives advice on how to mobilise support for changing the pharmacotherapy curriculum and how to perform research in this field.

During and following the implementation of changes in the curriculum the competence/performance of students should be assessed according to the levels required to meet the final year learning objectives. In order to stimulate the students to learn in the best possible way, they should be informed and instructed at the start of the learning programme about the methods of teaching and assessment. [12;13]

Research

Most studies of cognitive processes in medical education are focussed on (experienced) doctors who have already graduated.[14-16] For undergraduate teaching and learning it is also important to know how medical students can build up their expertise in pharmacotherapy skills together with gaining knowledge. Therefore, the way undergraduates learn how to choose and prescribe drugs, for example by think-aloud protocols could be studied. This could be done by comparing students following different types of curricula with those following curricula including context-learning in the training programme.

The studies described in this thesis, were mainly restricted to pre-clinical students. In particular, the effect of pre-clinical context-learning on the level of mastering pharmacotherapy knowledge and skills of graduates is not known. Therefore, it is recommended that the influence of pre-clinical context-learning in pharmacotherapy skills on actual performance should be studied during the clinical clerkships, and later in daily practice. To optimise the method of testing, further research on the validity and reliability of the tests is needed in order to be able to predict future behaviour in actual practice.

This latter is not an easy task because after graduation many other factors may influence drug-prescribing behaviour. Nevertheless, such studies should be

performed, since medical faculties have an obligation to society to provide graduates who are able to choose and prescribe drugs in a rational way.

This study contributed data to increase the available knowledge about medical education, in particular with respect to the context-learning and assessment of pharmacotherapy cognitive and communication skills. However,

> '*it will not be easy to convince conservative medical faculties, reasonably comfortable with the current conventions that allow clinical impressions to substitute for systematic accumulation of behavioural evidence, that change is in order. Neither will it be possible to convince them with data alone. But without data passionate arguments are bound to falter for, as one keen observer pointed out many years ago, where data are sparse opinions are plentiful. And that would seem to describe the status of clinical skills/competence/performance assessment in many parts of the globe'.* [1]

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Summary

This thesis deals with the analysis and amelioration of the pharmacotherapy training for undergraduate medical students. The general aim was to evaluate the level of competence in pharmacotherapy of medical students nearing graduation, and to seek ways to improve it if necessary. Competence in pharmacotherapy is defined as what the student is capable of doing in the field of pharmacotherapy, and consists of pharmacotherapy knowledge, skills and attitudes. For this purpose, four studies were designed and conducted. The main results and conclusions are summarised below.

In the **Introduction** it has been stated that preventable errors are being made in drug-prescribing and that irrational prescribing still occurs. Improvement in the drug-prescribing behaviour of medical doctors is not easy to achieve, because many factors influence this behaviour. It is possible that medical doctors have not been adequately trained in rational drug-prescribing and, therefore they cannot address optimally the factors that result in irrational prescription.

Before the level of competence in pharmacotherapy of final year students could be assessed, the learning objectives for pharmacotherapy (requirements the student has to meet) had to be determined. This was the aim of the first study, which is performed in 1995 and described in Chapter 2: **Learning objectives**. A survey was performed among the responsible heads of relevant clinical departments of all eight medical faculties in the Netherlands. First, by means of a literature survey, all known specific and general learning objectives were identified. Specific learning objectives describe the diseases and symptoms, the treatment of which should be mastered by final year students. General learning objectives describe the knowledge, skills and attitudes that are necessary to be able to treat these diseases and symptoms. For each disease the respondents were individually asked to indicate the required level of mastery needed for graduation with regard to the treatment, including the relevance of the necessary knowledge, skills and attitudes. To reach maximum consensus between the respondents, a so-called Delphi procedure was used. During this procedure the participants are repeatedly confronted with each other's opinion via a structured survey. In medical education and in clinical practice the Delphi procedure is an approved method to achieve consensus about a certain issue.

The study shows that for graduation, medical students should be able to master the treatment of 68 (out of 135) diseases and symptoms at the highest level (professional level): ability to choose the correct (drug)treatment and prescribe drugs independently for any patient. For 37 diseases the required level is the ability to choose the (drug) treatment, and for 9 diseases it is sufficient to have knowledge about the drugs which are relevant for the treatment. For the remaining 21 diseases no consensus was reached as to the level of mastery.
For the treatment of these 68 core diseases, medical students should master all relevant cognitive, communication and motor skills at the highest level, have sufficient knowledge of the basic principles of pharmacology and clinical pharmacology, and have a critical attitude towards disturbing influences which might cause irrational drug-prescribing.

After the learning objectives had been determined, the following study investigated whether final year medical students in the Netherlands met the requirements defined in the final year learning objectives for pharmacotherapy, i.e. the cognitive, communication and motor skills needed to treat the core diseases. This study is described in Chapter 3: **Competence in pharmacotherapy**. 76 6th year students from all Dutch medical faculties took two tests: a Short Essay test (SE) and an Objective Structured Clinical Examination (OSCE) in a simulated practice setting with standardised patients. In the SE, which was focused on 27 patient problems, three cognitive pharmacotherapy skills were tested: (1) choosing the (drug) treatment; (2) determining the patient information, and (3) determining the monitoring measurements. In the OSCE, which consisted of eight consultations concerning eight patient problems, not only the three cognitive skills were tested but also the communication and motor skills. During the OSCE, the students' performances were observed and the communication and motor skills were scored immediately. In both tests the cognitive skills were subsequently scored on a 4-point scale by independent experts in three medical disciplines from three universities: internal medicine, general practice and clinical pharmacology.
For the SE and the OSCE the mean scores for mastering the cognitive pharmacotherapy skills were 55.8% and 60.7%, respectively, of the required level for final year medical students. The score for communication and motor skills at

the OSCE test was 73.0% and 53.6%, respectively. Therapeutic errors, i.e. a score of 0 or 1 on the 4-point scale, varied from 18.6% to 84.1% for the performances of all cognitive, communication and motor skills during both tests.
The results of this study strengthen the opinion that in 1996 the competence of medical students nearing graduation did not meet the requirements for pharmacotherapy skills as defined in the final year learning objectives.

The main method of teaching is still often focused on learning knowledge first, followed by applying this knowledge in patient problems. In the following study, described in Chapter 4: **Ability to learn cognitive skills**, the aim was to determine whether 3rd year medical students could learn cognitive pharmacotherapy skills, i.e.: (1) choose the (drug) treatment; (2) determine the patient information, and (3) determine the monitoring measurements, simultaneously with obtaining the necessary knowledge of pharmacology.
In 1997, a controlled trial with a 9-month follow-up was conducted, in which a control group (42 students) followed the usual learning programme and a study group (43 students) followed an experimental programme in addition to the usual programme. The 85 students were randomly assigned to the study group and the control group. The experimental programme consisted of training in pharmacotherapy skills during four weekly group sessions combined with self-study. The programme was identical to the obligatory pharmacotherapy skills training for 5th year students who were about to enter their clinical clerkships. Before, immediately after, and again nine months after the training the 3rd year students were tested. The tests consisted of a knowledge test and a cognitive skills test. As a reference 38 5th year students took the same tests.
The study showed that before the training there was no difference in the level of the cognitive skills between the 3rd year study group and the control group: 26.7% and 27.4% of the required level for graduation, respectively. Immediately after the training the level of competence in the study group had increased (46.0%), and showed no significant decline nine months after the training (41.3%). The control group scored significantly lower on both post-tests: 36.7% and 36.3% respectively. There were no differences between the study group and control group with regard to the level of knowledge of pharmacology and

pharmacotherapy before (52.8/53.3% of the maximum), immediately after (69.1/66.4%) and nine months after the training (55.0/55.7%).
The level of cognitive skills of the 5th year students before and immediately after their obligatory training was more or less the same: 40.3% and 44.5% of the maximum; whereas their level of knowledge increased significantly from 48.8% to 68.0% of the maximum.
The conclusion was that 3rd year medical students were able to learn the pharmacotherapy cognitive skills simultaneously with gaining pharmacology and pharmacotherapy knowledge. The level of knowledge and skills of the 3rd year students after the training was similar to the level of the 5th year students. These students mainly 'brushed up' their 'rusty' knowledge. They were hardly able to acquire cognitive pharmacotherapy skills.

Based on the results of the above study, one might assume that the level of pharmacotherapy skills could increase considerably by implementing a pharmacotherapy teaching programme in the pre-clinical phase of the medical education. In Chapter 5: **Context-learning**, a context-learning programme is described and the results of the evaluation are presented. Context-learning means learning in the setting of the (future) profession, allowing the student to sink in the learned issues by repetitions and giving the students feedback on their performances. The students themselves are responsible for 'repairing' any lack of knowledge.
The aim of the study was to evaluate a pharmacotherapy context-learning programme for 2nd–4th year pre-clinical students with regard to their mastery of cognitive pharmacotherapy skills, ready-knowledge of pharmacotherapy and study-load, and the appreciation of the programme by the students and the examiners. The skills were (1) choosing the (drug) treatment and (2) determining the patient information.
An obligatory context-learning programme for pharmacotherapy skills was developed and gradually implemented in the 2nd-4th year training for a total of 750 students. A weekly session was organised for 108 2nd–4th year students. Each session consisted of a recapitulation lecture, a ready-knowledge test (correct answers: +1; wrong answers: -1; don't know: 0) and a role-play session in the form of consultations with three 'patients'. In the role-play session the students played

the role of 'doctor', 'patient' and 'peer-assessor'. After having attended 15 sessions, the 4th year students took the Objective Structured Clinical Examination (OSCE) in a setting similar to that of the role-play sessions, but more realistic. Each student treated three standardised patients in the outpatient clinic during a period of 45 minutes, being assessed on a 4-point scale by clinical examiners.

One year after the full implementation of the programme, in 2002 a random selection was made of 192 2nd–4th year students who had played the role of doctor in the role-play sessions and 49 4th year students who had taken the OSCE. The treatment and the patient information chosen by these students was collected, summarised on scoring sheets and assessed again by clinical experts. The scores for the ready-knowledge tests and the questionnaires were also collected.

During the role-play sessions the 2nd, 3rd and 4th year students mastered the cognitive skill 'choosing the (drug) treatment' at 43.3%, 45.0% and 51.0% of the required level for graduation, respectively. The OSCE level was 63.9%. This level was significantly lower than that of the group of 6th year students (72.6%: see Chapter 3) who had not participated in the context-learning programme.

During the role-play sessions the 2nd, 3rd and 4th year students mastered the cognitive skill 'determining the patient information' at 47.3%, 47.2% and 45.3% of the required level at graduation respectively. At the OSCE the level was 69.0%, which is significantly higher than that of the 6th year students (43.6%: see Chapter 3). With regard to the ready-knowledge test, the true-minus-false score of the 2nd, 3rd and 4th year students was 30.1%, 41.8% and 44.8% of the maximum score, respectively. The 3rd year students scored significantly higher than the 2nd year students. The students had spent approximately 1% of the total study time on the pharmacotherapy programme. They appreciated the role-play sessions at 78% – 82% of the maximum, and the OSCE as much as valued 99% of the maximum.

It can be concluded that the level of mastering cognitive skills increased in 2nd-4th year students because they had participated in the pharmacotherapy context-learning programme. The level of 4th year students in the OSCE is comparable with that of earlier tested 6th year students who had not participated in the context-learning programme, but who had almost finished their clerkships. This result was achieved with a minimum of study-load and a maximum of appreciation by the

students for the context-learning methodology, in which the setting resembled actual practice.

In the last chapter: the **General discussion**, the findings of the studies are discussed more generally. On the basis of a frequently quoted framework for discussing the assessment of clinical skills, competence and performance, with the consecutive layers 'Knowledge', 'Competence', 'Performance' and 'Action' it is explained that the layer 'Action' or 'Performance' implies the achievement of knowledge, as reflected in the more basic layers. On the other hand, assessment of the requirements as described in the lower layers does not fully predict the achievement in the higher layers. The short training programme described in Chapter 4, the context-learning programme presented in Chapter 5, and the assessments are discussed within this framework. The consequences for educational programmes and assessments are discussed in the light of the findings presented in Chapters 4 and 5.
Suggestions are made for changes in the (medical) education, to include more learning by participating in actual practice ('learning by doing'). Finally, recommendations are made for future training programmes and the assessment of competence in pharmacotherapy, as well as for future research in this field.

Samenvatting

Het thema van dit proefschrift is analyse en verbetering van het farmacotherapie-onderwijs voor studenten geneeskunde. Het algemene doel was het niveau van de farmacotherapeutische competentie van bijna afgestudeerde studenten geneeskunde te evalueren en, indien noodzakelijk, een onderwijsprogramma te ontwikkelen en te evalueren om het niveau van deze competentie te verbeteren. Onder farmacotherapeutische competentie wordt verstaan het beschikken over toepasbare farmacologische en farmacotherapeutische kennis en vaardigheden in therapeutische patiëntproblemen in combinatie met bekwaamheid in het (medicamenteus) behandelen van patiënten. Hiertoe zijn vier onderzoeken opgezet en uitgevoerd, waarvan de bevindingen hieronder worden samengevat.

In de **Introductie** wordt beschreven dat er vermijdbare fouten gemaakt worden in het voorschrijven van geneesmiddelen en dat er nog steeds irrationeel wordt voorgeschreven. Verbetering van het voorschrijfgedrag van praktiserende artsen is niet gemakkelijk omdat veel factoren invloed uitoefenen op dit gedrag. Het is mogelijk dat basisartsen niet voldoende getraind zijn in het rationeel voorschrijven van geneesmiddelen en (daardoor) onvoldoende in staat zijn weerstand te bieden aan de factoren die irrationeel voorschrijven tot gevolg hebben.

Voordat het niveau van farmacotherapeutische competentie van basisartsen kon worden vastgesteld, moesten eerst de eindtermen voor farmacotherapie (eisen waaraan de student moet voldoen) worden bepaald. Dit was het doel van het eerste onderzoek dat beschreven is in hoofdstuk 2: **Eindtermen**. Hiertoe werd in 1995 een gestructureerde enquête gehouden onder de verantwoordelijke hoogleraren van relevante klinische afdelingen van alle acht medische faculteiten in Nederland. Eerst werden uit de literatuur alle specifieke en algemene eindtermen verzameld. Specifieke eindtermen beschrijven de ziektes en symptomen, waarvan de basisarts de (medicamenteuze) behandeling dient te beheersen. Algemene eindtermen beschrijven de algemene kennis, vaardigheden en attitudes waarover de basisarts moet beschikken om deze ziektes en symptomen te kunnen behandelen. Per ziektebeeld bepaalden deze hoogleraren individueel het gewenste niveau waarover de basisarts moet beschikken, alsmede

de mate waarin kennis, vaardigheden en attitudes hiervoor relevant zijn. Om zoveel mogelijk overeenstemming over het gewenste niveau te krijgen tussen de hoogleraren, is een zogenaamde Delphi procedure gebruikt. Tijdens deze procedure worden de deelnemers bij herhaling geconfronteerd met elkaars mening via een gestructureerde enquête. In het medisch onderwijs en in de klinische praktijk is de Delphi procedure een beproefde methode om de mate van overeenstemming vast te stellen over een onderwerp.
Uit het onderzoek blijkt dat de basisarts de behandeling van 68 (van de 135) ziektebeelden en symptomen op het hoogste niveau dient te beheersen (professioneel niveau): het zelfstandig kiezen van de (medicamenteuze) behandeling en het voorschrijven van geneesmiddelen voor iedere patiënt. Bij 37 ziektebeelden is het vereiste niveau: het kiezen van de (medicamenteuze) behandeling, en bij 9 ziektebeelden: kennis hebben van de geneesmiddelen die relevant zijn bij de behandeling. Bij de overige 21 ziektebeelden werd geen overeenstemming bereikt over het te beheersen niveau.
Voor de behandeling van deze 68 ziektebeelden moeten basisartsen beschikken over voldoende kennis aangaande basisprincipes van farmacologie en klinische farmacologie; alle relevante cognitieve, communicatieve en motorische vaardigheden beheersen, en een kritische houding hebben ten aanzien van factoren die irrationeel voorschrijven in de hand kunnen werken.

Nadat de eindtermen voor farmacotherapie bepaald waren, werd in het volgende onderzoek nagegaan of studenten geneeskunde in Nederland voldoen aan de vastgestelde farmacotherapie eindtermen aangaande cognitieve, communicatieve en motorische vaardigheden. Dit onderzoek is beschreven in hoofdstuk 3: **Farmacotherapie competentie**. Hiertoe legden 80 6^{e} jaars studenten, afkomstig van alle Nederlandse medische faculteiten, twee testen af: een schriftelijke test met korte antwoorden (SE) en een stationsexamen (OSCE) in een nagebootste praktijksetting met simulatiepatiënten. Tijdens de SE, waarin 27 patiëntproblemen aan bod kwamen, werden drie cognitieve vaardigheden op het gebied van farmacotherapie getoetst: (1) het kiezen van de (medicamenteuze) behandeling; (2) het bepalen van de informatie voor de patiënt; (3) het vaststellen van het vervolgbeleid. Tijdens de OSCE, bestaande uit 8 consulten met

8 patiënten, werden naast deze drie cognitieve vaardigheden ook communicatieve en motorische vaardigheden getoetst. De studenten werden tijdens de uitvoering van de opdrachten geobserveerd, waarbij de communicatieve en motorische vaardigheden direct werden gescoord. De cognitieve vaardigheden van beide testen werden later door onafhankelijke beoordelaars gescoord op een 4-puntsschaal. Deze beoordelaars behoorden tot drie klinische disciplines: inwendige geneeskunde, huisartsgeneeskunde en klinische farmacologie, en waren afkomstig van drie medische faculteiten.
Op de SE was de gemiddelde score voor het beheersen van de cognitieve vaardigheden in farmacotherapie 55.8% van de vereiste score voor basisartsen en op de OSCE 60.7%. De score voor de communicatieve en motorische vaardigheden op de OSCE was respectievelijk 73.0% en 53.6%. Therapeutische missers, dat wil zeggen een score van 0 of 1 op de 4-puntsschaal, varieerden van 18.6 – 84.1% voor alle cognitieve, communicatieve en motorische vaardigheden die tijdens de SE en de OSCE werden uitgevoerd.
De resultaten van het onderzoek bevestigden de mening dat in 1996 in Nederland het niveau van de basisartsen niet voldeed aan de eisen volgens de vastgestelde eindtermen farmacotherapie aangaande de farmacotherapeutische vaardigheden.

In het huidige onderwijs leren studenten meestal eerst kennis en daarna het toepassen van deze kennis in patiëntproblemen. In het volgende onderzoek, dat is beschreven in hoofdstuk 4: **Vermogen om farmacotherapie te leren gelijktijdig met het verwerven van kennis**, was het doel om te bepalen of 3^{e} jaars studenten geneeskunde cognitieve vaardigheden op het gebied van de farmacotherapie kunnen aanleren, dat wil zeggen: (1) de (medicamenteuze) behandeling kiezen; (2) de informatie voor de patiënt bepalen, en (3) het vervolgbeleid vaststellen, tegelijkertijd met het verkrijgen van de benodigde farmacologische kennis.
Hiertoe is in 1997 een onderzoek opgezet met een follow-up van 9 maanden waarin een controlegroep (42 studenten) het normale onderwijsprogramma volgde, en een interventiegroep (43 studenten) een experimenteel programma kreeg naast het normale onderwijsprogramma. De 85 deelnemende studenten deden vrijwillig mee aan het onderzoek en werden gerandomiseerd toegewezen aan een van beide groepen. Dit programma bestond uit een training in

farmacotherapeutische vaardigheden gedurende 4 wekelijkse groepsbijeenkomsten en zelfstudie. Het programma was identiek aan het verplichte programma in farmacotherapeutische vaardigheden voor 5e jaars studenten aan het begin van de co-assistentschappen. De 3e jaars studenten legden drie testen af, voorafgaand aan en direct na de interventie en na 9 maanden. De testen bestonden uit een kennistest en een cognitieve vaardigheden-test: (1) het kiezen van de (medicamenteuze) behandeling; (2) het bepalen van de informatie voor de patiënt; (3) het vaststellen van het vervolgbeleid. Als referentie legden 38 5e jaars studenten dezelfde testen af.
Uit het onderzoek bleek dat bij de test voorafgaand aan het experimentele onderwijsprogramma het niveau van de cognitieve vaardigheden van beide 3e jaars groepen niet verschillend van elkaar waren (respectievelijk 26.7 en 27.4% van het vereiste basisartsniveau). Onmiddellijk na de training was het niveau van de interventiegroep gestegen (46.0%) en was 9 maanden na de training niet significant gedaald (41.3%). De controlegroep scoorde bij beide testen significant lager dan de interventiegroep (36.7 en 36.3%). Het kennisniveau aangaande farmacologie en farmacotherapie was niet verschillend tussen de interventie- en de controlegroep voorafgaand aan (52.8/53.3% van het maximum), direct na de interventie (69.1/66.4%) en na 9 maanden (55.0/55.7%).
Het niveau van de cognitieve vaardigheden van de referentiegroep van 5e jaars studenten voorafgaand aan en direct na hun verplichte training verschilde niet veel: 40.3 en 44.5% van het maximum. Het niveau van kennis steeg significant van 48.8 tot 68.0% van het maximum.
De conclusie van het onderzoek was dat 3e jaars studenten geneeskunde in staat zijn om farmacotherapeutische cognitieve vaardigheden aan te leren tegelijk met het verkrijgen van farmacologische en farmacotherapeutische kennis. Het niveau van kennis en vaardigheden van de 3e jaars studenten na de interventie gelijk is aan dat van de 5e jaars. 5e jaars studenten spijkeren hoofdzakelijk hun weggezakte kennis bij en komen nauwelijks toe aan het leren van farmacotherapeutische cognitieve vaardigheden.

Op grond van de resultaten van het bovenstaande onderzoek, was het te verwachten dat het niveau van farmacotherapeutische vaardigheden aanzienlijk

zou kunnen stijgen door het invoeren van een onderwijsprogramma farmacotherapie in de pre-klinische fase van de artsopleiding. In hoofdstuk 5: **Context-gebonden leren**, wordt een context-gebonden onderwijsprogramma in de farmacotherapie beschreven en de resultaten van een evaluatief onderzoek gepresenteerd.

Context-gebonden leren is leren in de setting van de (toekomstige) beroepsuitoefening waarbij de student feedback krijgt op de uitvoering van de opdrachten en het geleerde kan beklijven door herhaling. De student is zelf verantwoordelijk voor het bijspijkeren van ontbrekende kennis.

Doel van het onderzoek was de evaluatie van een context-gebonden farmacotherapie programma voor 2e–4e jaars studenten aangaande het beheersen van farmacotherapeutische vaardigheden, parate kennis over farmacotherapie, studielast en waardering van de studenten en docenten. De vaardigheden bestonden uit (1) Het kiezen van de (medicamenteuze) behandeling en (2) Het bepalen van de informatie voor de patiënt.

Een verplicht context-gebonden programma voor farmacotherapeutische vaardigheden werd ontwikkeld en geleidelijk ingevoerd in het 2e- 4e studiejaar voor alle 750 studenten. Hiertoe werd wekelijks een bijeenkomst georganiseerd voor 108 2e – 4e jaars studenten. Iedere bijeenkomst bestond uit een recapitulatiecollege, een parate kennis toets (goede antwoorden: +1 punt; foute antwoorden: – 1 punt; weet het niet: 0 punten) en een Praktijkoefening (rollenspel) in de vorm van een spreekuur met drie ‘patiënten’. Tijdens de Praktijkoefening hadden studenten de rol van ‘dokter’, ‘patiënt’ en ‘beoordelaar’. Nadat de studenten 15 bijeenkomsten bijgewoond hadden, legden de 4e jaars studenten de Praktijktoets af op soortgelijke wijze als tijdens de Praktijkoefening, maar in een realistische setting. Deze studenten behandelden 3 simulatiepatiënten in de polikliniek binnen 45 minuten, waarbij zij op een 4-puntsschaal beoordeeld werden door klinische examinatoren.

Een jaar na volledige invoering van het programma werden in 2002 tijdens de Praktijkoefening 192 studenten willekeurig geselecteerd en tijdens de Praktijktoets 49 4e jaars studenten. Alle studenten hadden de rol van ‘dokter’. De door deze studenten gekozen behandelingen en de verstrekte informatie voor de patiënten werden verzameld, overgenomen op overzichten en vervolgens opnieuw

beoordeeld door klinische experts. Eveneens werden de scores van de parate kennis toets en ingevulde vragenlijsten verzameld.

Tijdens de Praktijkoefening beheersten de 2e, 3e en 4e jaars studenten de vaardigheid 'Het kiezen van de (medicamenteuze) behandeling' op respectievelijk 43.3, 45.0 en 51.0% van het vereiste basisartsniveau. Op de Praktijktoets was het beheersingsniveau 63.9%. Dit niveau was significant lager dan dat van de groep 6e jaars studenten (72.6%: zie hoofdstuk 3) die het context-gebonden programma niet hadden gevolgd.

Tijdens de Praktijkoefening beheersten de 2e, 3e en 4e jaars studenten de cognitieve vaardigheid 'Het bepalen van de informatie voor de patiënt' op respectievelijk 47.3, 47.2 en 45.3% van het vereiste basisartsniveau. Op de Praktijktoets was het niveau 69.0% en dit niveau was significant hoger dan het niveau van de groep 6e jaars studenten (43.6%, zie hoofdstuk 3).

Aangaande de parate kennis toets was de goed-min-fout score van de 2e, 3e en 4e jaars studenten respectievelijk 30.1, 41.8 en 44.8% van de maximale score. De score van de 3e jaars studenten was aanzienlijk hoger dan die van de 2e jaars.

De studenten besteedden gemiddeld 1% van de totale studietijd aan het farmacotherapie programma. De waardering voor de Praktijkoefening door de studenten was van 78 – 82% van de maximaal haalbare waardering en voor de Praktijktoets 99%.

De conclusie van het onderzoek is dat het beheersingsniveau van de cognitieve vaardigheden steeg bij 2e-4e jaars studenten omdat zij het context-gebonden farmacotherapie programma hadden gevolgd. Het niveau van de 4e jaars studenten tijdens de Praktijktoets is vergelijkbaar met dat van eerder geteste 6e jaars studenten, die het context-gebonden onderwijs niet hadden gevolgd maar wel de co-assistentschappen. Dit resultaat werd bereikt met een minimum aan studiebelasting en een maximum aan waardering door de studenten voor de context-gebonden onderwijsmethode, waarbij de setting zo veel mogelijk leek op de echte praktijk.

In het laatste hoofdstuk, **Algemene Beschouwing**, worden de resultaten van de vier onderzoeken besproken aan de hand van een toetsingsmodel. In dit model worden vier lagen onderscheiden: feitenkennis; toepassen van deze kennis in

problemen; kennis en vaardigheden laten zien tijdens een toets; kennis en vaardigheden uitvoeren in de dagelijkse praktijk. Bij toetsing van activiteiten op het niveau van een hogere laag, wordt verondersteld dat de kennis en eventueel vaardigheden van een lagere laag beheerst worden. Toetsing van kennis en vaardigheden op een lager niveau heeft geen voorspellende waarde voor het presteren op een hoger niveau.

Aan de hand van het model worden het experimentele interventieprogramma uit hoofdstuk 4 en het context-gebonden onderwijsprogramma uit hoofdstuk 5 besproken. Daarna worden de gevolgen beschreven voor het opzetten van onderwijsprogramma's en de toetsing ervan, die voortvloeien uit de bevindingen van hoofdstuk 4 en 5. Vervolgens worden veranderingen in het (medisch) onderwijs voorgesteld, die vooral gericht zijn op meer leren en ervaring opdoen in de dagelijkse (klinische) praktijk. Tot slot worden aanbevelingen geformuleerd voor toekomstige onderwijsprogramma's farmacotherapie en voor toekomstig onderzoek hiernaar.

Appendix

Appendix 1

Case number: **T90A56** Disease: **Diabetes Mellitus 2**

Situation: **GP practice** Position: **doctor-assistant general medicine**

General patient information			
name: **Mrs J Wesseling**	*	profession: **teacher**	*
age (date of birth): **63 (12-9-40)**		intoxications: **-**	
sex: **female**		allergy: **-**	
civil status: **married**		pregnancy/lactation:	
children (age): **3 (31; 29; 25)**		other: **-**	
Summary medical history and present health status			
'98: Came to surgery. History: '88: HNP left L5-S1, treated conservatively. '96: femur-fracture left after a fall from a step-ladder at work. Post-operative physiotherapy; total recovery.			*
'00: sleeping problems due to imminent dismissal: temazepam 14 days (monitoring!)			

* tick off (v) essential pat. data!

Essence present findings *)

Mrs Wesseling came to your surgery, because last month she became increasingly thirsty and had to go to the toilet 2 – 3 times at night. Moreover, lately she often feels very tired.

After focussed history-taking, diabetes mellitus type 2 seemed to be the most likely cause of her complaints.

You have just performed a physical/additional examination:
- the blood glucose is 12.6 mmol/l (non-fasting) (reference value fasting: 5.6 mmol/l);
- the weight is 76 kg at a height of 1.60 m (QI: 30);
- the blood pressure is 150/85 mm Hg.

You make the working diagnosis **diabetes mellitus type 2**.

Assignment:
Before the consultation (5 minutes):

1. Draw up your management/treatment plan.

During the consultation (10 minutes):

2a. Inform the patient about your findings of history and examination;
2b. Discuss your management/treatment plan with the patient;
2c. Execute the management/treatment on the patient.

*) Only deviating findings are mentioned; other (non-mentioned) data are normal.

Case number: **T90B65** Disease: **Diabetes Mellitus 2**

Situation: **GP practice** Position: **doctor-assistant general medicine**

General patient information			
name: **Mr JH Geluk**	*	profession: **retired porter**	*
age (date of birth): **67 (12-8-36)**		intoxications: **-**	
sex: **male**		allergy: **-**	
civil status: **married**		pregnancy/lactation: **-**	
children (age): **3 (38; 35; 30)**		other: **-**	
Summary medical history and present health status			
'96: Came to surgery. History: '89: sleeping problems (advice, temazepam 10 days, monitoring!) '95: diverticulose sigmoid: lactulose syrup 0,5g/g during 4 weeks, motor advice			*
'98: light distorsion left knee after fall with bicycle: prescribed rest, if necessary ibuprofen for 10 days			
'00: spastic colon: mebeverine suspension during 14 days; motor advice.			
'03 dec.: Diab.mellitus 2; bl.gluc. non-fasting: 13 mmol/l; fasting: 9 mmol/l (normal value fasting: 5.6 mmol/l); weight 86kg, height 1.76m (QI:28), RR: 150/90 mm Hg; ther.: dietician advice			

* tick off (v) essential pat. data!

Essence present findings *)

Mr Geluk came to your surgery. Four weeks ago you diagnosed diabetes mellitus and referred him to a dietician for advice about his life-style and nutrition (see summary above). He is now visiting you for a check-up of his blood glucose.
The patient says he sticks to the diet. The complaints, however, remain more or less the same (increasingly thirsty, having to go to the toilet 2 – 3 times at night, getting tired more often).

After focussed history-taking, the blood glucose appeared to not have declined sufficiently.

You have just performed a physical/additional examination:
- the blood glucose is 9 mmol/l (fasting; normal value fasting: 5.6 mmol/l);
- the weight is 93 kg at a height of 1.76m (QI: 30);
- the blood pressure is 160/90 mm Hg.

You make the working diagnosis **diabetes mellitus type 2, not sufficiently reacting to 4 weeks of diet**.

Assignment:
Before the consultation (5 minutes):

1. Draw up your management/treatment plan.

During the consultation (10 minutes):

2a. Inform the patient about your findings of the history and examination;
2b. Discuss your management/treatment plan with the patient;
2c. Execute the management/treatment on the patient.

*) Only deviating findings are mentioned; other (non-mentioned) data are normal.

Case number: **T90C65** Disease: **Diabetes Mellitus 2**

Situation: **GP practice** Position: **doctor-assistant general medicine**

General patient information			
name: **Mr HB Postma**	*	profession: **warden nursing home**	*
age (date of birth): **55 (12-9-48)**		intoxications: **-**	
sex: **male**		allergy: **-**	
civil status: **married**		pregnancy/lactation:	
children (age): **3 (28; 25; 20)**		other: **-**	
Summary medical history and present health status			
'98: History: '89: sleeping problems (advice, temazepam 10 days, monitoring!) '95: diverticulose sigmoid: lactulose syrup 0,5g/g for 4 weeks, motor advice			*
'99: Essential hypertension (repeated RR: 200/105 mm Hg); 4 weeks diet no effect; started with hydrochloorthiazide; weight: 88 kg, height 1.76 (QI: 28)			
'00: Spastic colon: motor advice; later: mebeverine for 14 days; Monitoring RR: 140/90 mm Hg, continue hydrochloorthiazide; weight 86 kg			
'01: Astma bronchiale: salbutamol 100 mcg if necessary 1-2 puffs. Monitoring RR: 140/90 mm Hg, continue hydrochloorthiazide; weight 86 kg Bronchitis viral: conservative treatment, relapsing bronchitis: salbutamol 200 mcg if necessary 1-2 puffs + beclomethason 200 mcg 2 dd 1 puff			
'02 Monitoring RR: 140/85 mm Hg, blood glucose: 7.5 mmol/l (non-fasting), weight 87 kg. Continue: HCT 25 mg 1 dd; salbutamol 200 mcg if necessary 1-2 puffs + beclomethason 200 mcg 2 dd 1 puff; advice: lose 10 kg.			
'03 dec.: Monitoring RR: 150/95 mm Hg, blood glucose 8 mmol/l (non-fasting), weight 87 kg. Continue: hydrochloorthiazide 25 mg, tab, 1 dd 1; salbutamol 200 mcg + beclomethason 200 mcg 2 dd ; diet (dietician).			

* tick off essential pat. data!

Essence present findings *)

Mr Postma came to your surgery for a check-up of his blood pressure, blood glucose and weight. Since last month, he doesn't feel very well. He is very thirsty and has to go the toilet 2 – 3 times at night. Moreover, lately he often feels tired.

After focussed history-taking, diabetes mellitus type 2 appeared to be the most likely cause of his complaints.

You have just performed a physical/additional examination:
- the blood glucose is 13 mmol/l (non-fasting; normal value fasting: 5.6 mmol/l);
- the weight is 86 kg at a height of 1.76 m (QI: 28);
- the blood pressure is 150/90 mm Hg.

You make the working diagnosis **diabetes mellitus type 2**.

Assignment:
Before the consultation (5 minutes):

1. Draw up your management/treatment plan.

During the consultation (10 minutes):

2a. Inform the patient about your findings of the history and examination;
2b. Discuss your management/treatment plan with the patient;
2c. Execute the management/treatment on the patient.

*) Only deviating findings are mentioned; other (non-mentioned) data are normal.

Appendix 2

Extended prescription paper

Case Student

Starting points and management choices	Name: Address: Phone R/ Date: Name patient: Date of birth: Address:
Essential patient information: - - - - - Actual patient problem /diagnosis: - - - - - - Therapeutic goal: - - - - Management/ therapeutic choice: - - - - -	

Appendix 3 Evaluation form PO and PT

Evaluation Competence Pharmacotherapy Test number: | | | | | | | |

Date: Case number: | | | | | | | |

Name doctor: Student number: | | | | | | | |

Name assessor: Student number: | | | | | | | |

Name patient: Student number: | | | | | | | |

A. STARTING POINTS	**I M S E**

1. Essential patient information, written on the extended prescription paper: i m s e (01)
   Gender; age; (no)co-morbidity; (no)co-medication;
   (no)pregnancy / lactation; (no)allergy; (no)intoxications:

2. Present patient problem, written on the extended prescription paper: i m s e (02)
   Ask for help / complaint; course since start complaint(s); actual seriousness; (diff.)diagnosis:

B. MANAGEMENT / THERAPY CHOICE AND PRESCRIPTION	**I M S E**

1. The student order additional diagnostics (for / by physician himself): n i m s e (03)
   To which aim; which diagnostics; to which authority; within what time:

2. The student refer the patient: n i m s e (04)
   To which (para) medical specialist;
   To which aim (diagnosis / therapy);
   Within what time:

3. The student choose the therapy:
   a. Therapeutic goal: n i m s e (05)
      which aim; when to achieve; to what extent aim has to be reached:
   b. Non-medicinal therapy / alteration: n i m s e (06)
      which therapy; how executed; when to start; length of therapy:
   c. Medicinal therapy / alteration: n i m s e (07)
      medicine 1: strength; administering form; dosage; tot. quantity
      medicine 2: strength; administering form; dosage; tot. quantity
      medicine 3: strength; administering form; dosage; tot. quantity

4. The prescription of the student is complete and readable: n i m s e (08)
   Info doctor;medicine;strength;adm.form;dosage;quantity;signature;info patient:

C. CONSULTATION (p.t.o. for specific evaluation)	**I M S E**

1. Patient communication (content) of the student: i m s e (09)
2. Patient communication (form) of the student: i m s e (10)
3. Attitude of the student: i m s e (11)
4. Patient experience during consultation: i m s e (12)

D. KNOWLEDGE AND ARGUMENTATION	**I M S E**

1. The student shows knowledge and understanding about the disease of patient: i m s e (13)
2. The student shows knowledge and understanding of relevant therapy / medicines: i m s e (14)
3. The student is able to reason with respect to choice(s) monitoring / therapy: i m s e (15)
   systematic considerations based on:
   efficiency, safety, suitability, costs

E. TOTAL SCORE	**I M S E**

signature doctor: signature assessor: signature patient:

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n: not relevant; **i**: insufficient; **m**: moderate; **s**: sufficient; **e**: excellent

C. CONSULTATION (specific evaluation during surgery) **I M S E**

1. Patient communication (content) of the student: I M S E (09) ➡

a. Explanation diagnosis / therapy to the patient:
Diagnostic findings; diagnosis: ……..…… i m s e
Additional diagostics.; refer: ……..…… n i m s e
Proposal/consultation (no) therapy; prognosis: ..…….. …… i m s e

b. Explanation effects of therapy to the patient:
Which symptoms (do not) disappear: ……..…… n i m s e
When do symptoms disappear: ……..…….. n i m s e

c. Explanation side-effects of therapy to the patient:
Which side-effects can occur: …… n i m s e
What to do if they occur: ……..…….. n i m s e

d. Give instructions to the patient:
How to take/use the medicine: ……. ……..…… n i m s e
How often, how much and how long (cure):…….. …… n i m s e
What to avoid during med. use: …….. …… n i m s e

e. Make appointments with the patient:
Yes / no come back, when: ……..…….. i m s e
When come back earlier: ……..…….. i m s e

2. Patient communication (form) of the student during consultation: I M S E (10) ➡
Explanation in clear language: ……..…….. i m s e
Use of reference books: ……..…….. i m s e
Write during surgery: ……..…….. i m s e
Check if it is understood: ……..…….. i m s e
Ask for questions: ……..…….. i m s e
Other: …… n i m s e

3. Attitude of the student: I M S E (11) ➡
Attention / respect for (reactions) patient:…… i m s e
Professional attitude: ……..…….. i m s e
Other: ……..…….. n i m s e

4. Patient experience during consultation: I M S E (12) ➡
Explanation disorder and therapy: ……..…….. i m s e
Instruction and appointments: ……..…….. i m s e
Attitude doctor: ……..…….. i m s e
Other: ……..…….. n i m s e

Additional remarks

n: not relevant; **i**: insufficient; **m**: moderate; **s**: sufficient; **e**: excellent

Dankwoord

Curriculum Vitae

Mijn proefschrift is klaar! Al weer 11 jaar gelden ontstond het initiatief hiervoor en gedurende de afgelopen 10 jaar heb ik onder andere aan de onderzoeken gewerkt die hierin beschreven staan. Onderzoek van medisch onderwijs is alleen mogelijk dankzij de bijdrage van de vele studenten, docenten en simulatiepatiënten. Iedereen wil ik hiervoor bedanken. Hier kan ik mij niet tot iedereen persoonlijk richten. Voor een aantal mensen maak ik echter een uitzondering.

Tijdens de bijeenkomsten van de Interuniversitaire Werkgroep Farmacotherapie-onderwijs onder de bezielende leiding van Cees van Winzum, ontstond het idee om te onderzoeken hoe het gesteld was met dit onderwijs. In deze werkgroep was ik de enige die nog niet gepromoveerd was. Het lag voor de hand dat ik dit idee zou uitwerken tot een project dat misschien zou uitmonden in een promotieonderzoek. Cees kon niet meer bij de afronding zijn.

Theo, in de beginperiode was je als ‘kersverse doctor’ nog in Groningen en daardoor was je meer op de achtergrond aanwezig. Later werd je benoemd tot hoogleraar op het VUmc en nam je de dagelijkse begeleiding over. Ik prijs mij zeer gelukkig dat je naar Amsterdam gekomen bent. Nieuwe ideeën over onderwijs konden we uitwerken in het laatste onderzoek. Deze samenwerking was zeer inspirerend en ik kijk er met veel plezier op terug. Jij was de denker die ik als doener nodig had! Jouw goede en eerlijke begeleiding in combinatie met unieke ‘peptalks’ waren goud waard. Ik heb in deze jaren veel van je geleerd, vooral het ontdekken van mijn sterke en zwakke kanten bij het uitvoeren van onderzoek en het verwerken ervan tot leesbare artikelen. Wat betreft het werk zijn onze wegen uit elkaar gegaan doordat de drang naar patiëntenzorg sterker was dan naar onderwijs en wetenschappelijk onderzoek. Ik waardeer de manier waarop je hiermee bent omgegaan. Ik ben er trots op dat ik de eerste promovenda ben die bij je promoveert.

Jaap, jij hebt mij in de beginfase begeleid, toen ik - niet gehinderd door kennis - aan het project begon. Je gaf steeds nauwkeurig commentaar op mijn

manuscripten. Je enthousiasme voor het onderzoeksproject is gebleven, ook toen de dagelijkse begeleiding was overgenomen.

Marten, in Indonesië heb ik je leren kennen als een nuchtere en pragmatische man met een helikopterblik. Je kunt snel een analyse maken van problemen of situaties. Hierdoor ben je onmisbaar geweest in de promotiecommissie. Dat was ook het geval buiten deze besprekingen om, omdat je deur altijd open stond om goede raad te geven.

Jacqueline, je was onmisbare hulp bij de redactie van het proefschrift en bewerkstelligde daardoor een versnelling. Het bleek dat wij meer samen deelden dan enthousiasme voor het farmacotherapie-onderwijs. Als de natuur ons welgezind is, kunnen we ook tijd besteden aan onze andere gemeenschappelijke hobby.

De begeleidingscommissie vanuit de subsidiegevers (Begeleidingscommissie Innovatie Farmacotherapie Onderwijs, BIFO) dank ik voor hun kritische vragen, nuttige adviezen en het vertrouwen dat in mij gesteld werd.

De leden van de promotiecommissie dank ik voor hun aanwezigheid bij de promotie ceremonie. De commissie bestaat uit: prof. dr. Th.J. ten Cate, prof.dr. S.A. Danner, prof. dr. R.J.B.J. Gemke, dr. H.V. Hogerzeil, Prof. dr. M. Orme and prof. dr. W.A.B. Stalman.

Veel huisartsen en specialisten hebben belangeloos meegewerkt als beoordelaar om honderden antwoorden van de studenten te scoren. Zonder hun inzet was het onmogelijk geweest. Ferry, ik kon er blind op vertrouwen dat je mij altijd van dienst wilde zijn, ondanks je eigen promotieonderzoek en je coördinatorschap van het Klinisch Lijn Onderwijs. Het is een eer voor mij dat je paranimf wilt zijn bij de verdediging.

In mijn nieuwe werkkring op het Jan van Breemen Instituut, is de belangstelling en steun onverwacht groot. Ik ervaar dit als kenmerkend voor de sfeer op het werk en ga met vertrouwen mijn toekomst hier tegemoet.

Mijn lieve vrienden en familie behoren tot de groep ondersteuners die belangrijke randvoorwaarden geschapen hebben om het tot een goed einde te brengen. Jullie hebben steeds gemeende interesse getoond en veel geduld opgebracht omdat ‘het boekje’ de afgelopen jaren steeds nog-net-niet af was.

Lieve Ma, uw wens dat een van de kinderen dokter zou worden, is uitgekomen. Dankzij het doorzettingsvermogen dat ik van u geleerd heb, heb ik na omzwervingen mijn roeping niet ontlopen en promoveer ik zelfs. Gelukkig kunt u er bij zijn. Jammer dat Pa er niet meer is: jullie zouden beiden glimmen.

Lieve Ruud, levensmaatje door dik en dun sinds 1977. We begonnen in 1993 samen enthousiast aan het opknappen van ons droomhuis en aan mijn promotieonderzoek. De planning was om beide klussen in ongeveer 5 jaar te klaren. In beide gevallen waren het werk en de bijkomende hindernissen niet te overzien; het liep ongelofelijk uit. Achteraf gezien is het de moeite zeker waard geweest. Nu het allemaal (vrijwel) klaar is kunnen we trots zijn op de voorwaarden die we geschapen hebben om te kunnen genieten en een andere invulling te geven aan de ‘p’. Ik verheug mij erop om samen met jouw een nieuwe levensfase in te stappen en nog heel lang samen op ontdekkingstocht te gaan in onszelf en in de wereld. Bedankt voor jouw onvoorwaardelijke liefde, steun en vertrouwen.

Joke Vollebregt werd op 17 maart 1954 geboren in Wieringerwerf. Na de middelbare school ging zij in 1972 lichamelijk opvoeding studeren aan de Academie voor Lichamelijke Opvoeding in Amsterdam. Ze volgde de studie Geneeskunde aan de Universiteit van Amsterdam en behaalde in 1988 cum laude haar artsexamen.
Tussen 1976 en 1981 werkte zij als lerares lichamelijke opvoeding op scholen voor lager en voortgezet onderwijs. Vervolgens heeft zij tot 1990 gewerkt als AGNIO Inwendige Geneeskunde in het MCA (Alkmaar) en het AMC (Amsterdam). In 1990 werd zij docent vaardigheidstraining van het Algemeen Co-Assistentschap (ALCO) aan de faculteit geneeskunde van de Vrije Universiteit te Amsterdam en van 1991 tot 1994 hoofd. Van 1994 tot 1997 was zij als onderwijscoördinator gedetacheerd op het onderzoeksproject 'Innovatie Farmacotherapie-onderwijs'. Van 1997 tot januari 2003 was zij werkzaam als universitair docent op de afdeling Medische Farmacologie.

Het wetenschappelijk onderzoek dat resulteerde in dit proefschrift werd tussen 1994 en 2003 aan de medische faculteit van de VU verricht.

Van 1990 tot 1993 volgde zij de opleiding Manuele Geneeskunde in Eindhoven. Vanaf 1993 tot 2002 heeft zij als arts manuele geneeskunde gewerkt in Heemstede en Bussum. Vanaf januari 2003 werkt ze in het Jan van Breemen Instituut als stafarts revalidatiegeneeskunde en arts manuele geneeskunde. Haar aandachtsgebieden zijn chronische pijnsyndromen en artrose.